7. HUMAN HEALTH RISK ASSESSMENT

7.1 INTRODUCTION

This risk assessment is part of the RSE for AA 3 at the former MCAS El Toro, California. Detailed information regarding the RSE (e.g., nature and extent of contamination, contaminant transport and fate) is contained in Sections 3, 4, and 5 and the approved work plan, wherein the risk assessment objectives have been outlined (Earth Tech 2002a). However, where appropriate, information that is relevant to the interpretation of the risk evaluation has been summarized and included herein to provide the facts that were considered prior to completing the risk evaluation.

A human health PRE was conducted for AA 3 to help risk managers determine if further action at the site is warranted. The decision for further action will be based on the potential for adverse human health effects as a result of exposure to chemicals detected at the site. These chemicals, termed COPCs, were identified and risk was evaluated for receptors that exist now (current conditions) or those that may exist in the future (future conditions). Analytical results from surface soil, subsurface soil, and groundwater analyses were used to identify the human health COPCs for each exposure medium evaluated in the PRE.

7.1.1 Human Health Preliminary Risk Evaluation

A human health PRE was completed for AA 3. The PRE quantitatively focused on the potential for human exposure to surface and subsurface soil and groundwater that may have been impacted by contamination from past operations (i.e., excavation of soils for use as borrow material and/or placement of construction debris resulting from non hazardous operations). As noted in the approved work plan (Earth Tech 2002a), a preliminary determination was made documenting that the potable use of groundwater in the area was negligible, despite its classification as a potential drinking water source. However, the groundwater is used in agricultural irrigation operations, so the PRE evaluates potential exposure to, and risk from, this medium under both residential and agricultural exposure scenarios.

7.1.2 Guidance Documents

The human health PRE is based on a standard approach developed in accordance with guidelines from the following documents and communications:

- Risk Assessment Guidance for Superfund (RAGS), Volume 1, Human Health Evaluation Manual (Parts A and B) (EPA 1989a, 1991b)
- Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual Supplemental Guidance, Standard Default Exposure Factors (EPA 1991b)
- Exposure Factors Handbook (EPA 1997a),
- Protocol to Conduct Human Health and Ecological Risk Assessments for the U.S. DoN, Pacific Division, (Earth Tech 2002a)
- Communications between EPA Region IX Toxicologist Dr. Daniel Stralka and Xuannga Mahini of Ogden Environmental and Energy Services, Inc. (Stralka 1995)
- DoN Risk Policy 5090 Ser N453E/1U5951 (DoN 2001)

Additional guidance was derived from correspondence and discussion with the principal investigators and is referenced where deemed of key relevance to the PRE. Risk assessments are key components of the Environmental Restoration Program employed by the DoN. Per the DoN policy

5090 Ser N453E/1U5951 (DoN 2001), the determination of human health risk at a site of concern is clearly prescribed to ensure sufficient resources are allocated for the protection of human health. The U.S. Navy policy for conducting human health risk assessments (HHRAs) identifies a three-tiered approach that may be implemented in its entirety depending on the level and nature of excess risk or hazard that is determined in prior tiers. The tiers that are discussed in the DoN policy are listed below.

Tier 1 - Screening Risk Assessment (SRA)

Tier 2 - Baseline Human Health Risk Assessment (BHHRA)

Tier 3 - Evaluation of Remedial Alternatives

This document comprises of the Tier 1, the SRA. The purpose of the Tier 1 SRA is to identify COPCs that may pose undesirable risks to human health, thus focusing efforts on those constituents most likely to be associated with excess human health risks. The Tier 1 SRA consists of two parts: Tier 1A; the screening PRE (SPRE) and Tier 1B; a site specific PRE (SSPRE).

In certain instances, a PRE is not required, such as when no or negligible contamination is detected at a site. The PRE is, however, conducted if analytical data from the site investigation indicate that contamination is, or may be, of sufficient magnitude and distribution to warrant continuance of the risk assessment process.

The Tier 1A SPRE methodology is consistent with RAGS (EPA 1989a, and 1991b) and is conducted using the EPA Region IX PRGs (EPA 2002a) for the residential and industrial exposure scenarios as the basis for comparison with site data. Based on recommendations from EPA Region IX (Stralka 1995), the Tier 1A SPRE is performed when

1. The complete or potentially complete exposure pathways of concern at a site are the same as those used to develop EPA Region IX PRGs (EPA 2002a), and
2. Pathway-specific exposure factors are expected to be similar to those used by the EPA for calculation of residential and/or industrial PRGs.

If complete, or potentially complete exposure pathways for the site are not addressed in the use of the PRG tables (e.g., residential and construction/excavation worker), or if site conditions warrant the use of exposure factors that differ from those used to develop EPA Region IX PRGs, a Tier 1B SSPRE is performed. Additionally, if the Tier 1A results indicate potentially significant health risks, the analysis proceeds to Tier 1B to derive more realistic, site-specific levels of risk.

7.2 DATA EVALUATION AND REDUCTION

7.2.1 Data Quality Assessment

Section 4.11 presents the details of the data quality assessment process and results of the data. The following text summarizes the methods used to perform a data quality assessment for application to the PRE.

A data quality assessment was conducted, which included a review of analytical methods; reporting limits; laboratory, field, and method blanks, and quality assurance and quality control (QA/QC) procedures. This section presents the results of the data quality assessment for each element most pertinent to the PRE.

Soil and groundwater data were reviewed in the following manner:

- 10 percent of the analytical data were validated according to Navy "Level D" data validation criteria.
- 90 percent of the data were validated according to Navy "Level C" (NFESC 1999).
- 100 percent of the data in the database were checked against data sheets received from the data validation personnel.

None of the data collected for the purpose of conducting the HHRA at AA 3 were qualified as rejected. In accordance with the conceptual site model (CSM) presented in the work plan (Earth Tech 2002a), soil data were segregated into surface and subsurface soil data. As noted previously, surface soil is defined as soil in the depth interval of 0 to 1 feet bgs and subsurface soil samples were defined as greater than 1 to 10 feet bgs.

7.2.2 Sample Reporting Limit Evaluation

The magnitude of the sample reporting limits may have a substantial effect on the results of the risk assessment. For instance, the potential presence of chemicals in environmental media at concentrations below the highest sample reporting limit could result in a potential underestimation of cancer risk or adverse non carcinogenic health effects if exposure were to occur. However, it is also possible that these chemicals are not present below the reporting limit; as such, the assumption that the chemical is present would potentially result in an overestimation of adverse health effects. For these reasons, an evaluation of the sample reporting limits was performed before cancer risk or noncarcinogenic health effects were assessed.

Table 7-1 presents data for those chemicals with non-detect values (i.e., reporting limits) that exceed a designated screening criterion. These screening criteria were selected as follows:

- For soil samples, the screening criterion was the EPA Region IX residential soil PRG (EPA 2002).
- For groundwater, the screening criterion was the federal MCL. — use PRGs

If sample reporting limits exceeded the screening criteria or appeared to be inordinately high relative to other samples evaluated, an additional evaluation of the data was performed in the data reduction step.

Table 7-1 compares screening criteria to reporting limits and shows the frequency of reporting limits exceeding the screening criteria. For soils, these data show that essentially all of the chemicals exhibited a predominance of reporting limits at or less than the screening criteria; thus data are sufficient for use in the risk assessment. For water samples, all of the chemicals exhibited a predominance of reporting limits at or less than the screening criteria; thus, further evaluation was not required.

The influence of elevated reporting limits on the PRE results is qualitatively discussed in the Section 7.7, Uncertainty Analysis).

7.2.3 Data Reduction

The SPRE focuses on data from the impacted area(s) within the study site. Chemicals that have been detected at least once are considered COPCs for the Tier 1A screening PRE. Relevant data sets are identified to facilitate the estimation of chemical exposure point concentrations (EPCs) to which receptors may reasonably be exposed. If environmental samples are analyzed for a chemical using more than one analytical method, then the results that are most reliable (as indicated by data validation qualifiers or laboratory data qualifiers), have the lowest detection limits, and provide the most representative environmental concentrations with respect to exposure are selected. Ultimately, conclusions and recommendations of the risk assessment are often based on the reasonable maximum exposure (RME) that a receptor may encounter. Key in determining the RME is a statistical evaluation of the data set, which provides summary statistics such as maximum detected concentration, minimum detected concentration, number of detects, and upper confidence levels on the mean value. Prior to making this summary, the data set was manipulated or reduced for input into the risk model. Thus, the data set was "reduced" by (a) averaging original and field duplicate samples to yield one data point per sampling locus, (b) choosing appropriate analytical methods, and (c) eliminating elevated or inordinately high non-detect values. Each of these steps is discussed below.

7.2.3.1 FIELD DUPLICATE SAMPLES

For soil samples, field duplicates were treated in the following manner:

Case 1: The original sample and field duplicate results for the COPC were above the reporting limit for the COPC.

Both values were averaged to obtain an average concentration for the sample pair before the statistical summary was performed.

Case 2: One sample of the duplicate pair had a concentration that was non-detect for the COPC, while the other exceeded the reporting limit.

The non-detect value was assigned a value of one-half its reporting limit and was then averaged with the detected concentration. If a qualifier existed on the detected concentration, that qualifier remained with the "averaged" value.

Case 3: Both samples had COPC concentrations that were non-detect.

The two values (i.e., reporting limit) were averaged to obtain an average reporting limit for the sample pair. Prior to summarizing the data statistically for EPC determination (i.e., calculation of the 95th upper confidence limit [UCL] on the arithmetic mean), the average reporting limit of the sample pair was then assigned a value of one-half of that average reporting limit. In so doing, the underestimation of risk due to use of a "biased low" data set (resulting from assigning the surrogate concentration twice during the process) was minimized.

7.2.3.2 ELEVATED REPORTING LIMITS

One or more sample-specific factors (e.g., matrix interferences) may result in reporting limits for a particular chemical that, in some samples, may be unusually high. Sometimes these elevated reporting limits greatly exceed the detected results for the same chemical in other samples, suggesting that the elevated reporting limit is not representative of the data set as a whole or site conditions. Inclusion of these data when determining the EPCs (e.g., calculating the 95 percent UCL) could correspondingly result in poorly characterized risk (EPA 1989a). Therefore, those sample reporting limits that exceed the maximum detected concentration by twice or greater than the maximum detected concentration for that chemical were not included in the statistical analysis.

Table 7-1: Nondetect Values Above Human Health Screening Criteria

Chemical	Screening Criteria[a]	Reporting Limit	RL Required[b]	FOE
Surface Soil (mg/kg)				
Antimony	3.06E+00	0.28 - 7.5	3	91.7%
Berylium	6.69E-01	0.029 - 0.5	0.2	33.3%
PHC as Diesel Fuel	1.00E+01	10 - 100	10	78.3%
PHC as Gasoline	1.00E+01	9.5 - 12	10	50.0%
PHC as Motor Oil	1.00E+01	13-Oct	10	81.3%
Selenium	3.20E-01	0.61 - 0.75	0.3	100.0%
Silver	5.39E-01	1 - 1.3	0.5	100.0%
Sodium	4.05E+02	11.2 - 250	100	83.8%
Thallium	4.20E-01	0.81 - 1	0.4	100.0%
Surface Soil (ug/kg)				
1,1,1,2-Tetrachloroethane	3.19E+03	4.6 - 6.4	5	83.8%
1,1,1-Trichloroethane	1.20E+06	4.6 - 6.4	5	83.8%
1,1,2,2-Tetrachloroethane	4.08E+02	4.6 - 6.4	5	83.8%
1,1,2-Trichloroethane	7.29E+02	4.6 - 6.4	5	83.8%
1,1,2-Trichlorotrifluoroethane	5.60E+06	4.6 - 6.4	5	83.8%
1,1-Dichloroethane	2.79E+03	4.6 - 6.4	5	83.8%
1,1-Dichloroethene	1.24E+05	4.6 - 6.4	5	83.8%
1,2,3-Trichloropropane	5.01E+00	4.6 - 6.4	5	83.8%
1,2,4-Trichlorobenzene	6.50E+05	510 - 1200	500	100.0%
1,2-Dichlorobenzene	3.70E+05	510 - 1200	500	100.0%
1,2-Dichloroethane	2.78E+02	4.6 - 6.4	5	83.8%
1,2-Dichlorotetrafluoroethane	--	4.6 - 6.4	5	83.8%
1,2-Dichlorpropane	3.42E+02	4.6 - 6.4	5	83.8%
1,3-Dichlrobenzene	1.59E+04	510 - 1200	500	100.0%
1,4-Dichlorobenzene	3.45E+03	510 - 1200	500	100.0%
2,2'-oxybis(1-Chloropropane)	--	510 - 1200	500	100.0%
2,4,5-Trichlorophenol	6.11E+06	510 - 1200	500	100.0%
2,4,6-Trichlorophenol	6.95E+03	510 - 1200	500	100.0%
2,4-Dichlorophenol	1.83E+05	510 - 1200	500	100.0%
2,4-Dimethylphenol	1.22E+06	510 - 1200	500	100.0%
2,4-Dinitrotoluene	1.22E+05	510 - 1200	500	100.0%
2,6-Dinitrotoluene	6.11E+04	510 - 1200	500	100.0%
2.4-Dinitrophenol	1.22E+05	2500 - 5900	2500	97.3%
2-Butanone	7.33E+06	92 - 130	100	70.3%
2-Chloronaphthalene	4.94E+06	510 - 1200	500	100.0%
2-Chlorophenol	6.34E+04	510 - 1200	500	100.0%
2-Hexanone	--	46 - 64	50	83.8%
2-Methyl-4,6-Dinitrophenol	--	2500 - 5900	2500	97.3%
2-Methylnaphthalene	--	25 - 51	25	91.9%
o-Cresol	--	510 - 1200	500	100.0%
2-Nitroaniline	1.75E+03	2500 - 5900	2500	97.3%
2-Nitrophenol	--	510 - 1200	500	100.0%
3,3'-Dichlorobenzene	1.08E+03	1000 - 2400	500	100.0%
M/P-Cresol	--	510 - 1200	500	100.0%
3-Nitroaniline	--	2500 - 5900	2500	97.3%
4-bromophenyl-phenylether	--	510 - 1200	500	100.0%
4-Chloro-3-Methylphenol	--	510 - 1200	500	100.0%
4-Chloroaniline	2.44E+05	1000 - 2400	1000	81.1%
4-Chlorophenyl-phenyl ether	--	510 - 1200	500	100.0%
4-Methyl-2-pentanone	7.87E+05	46 - 64	50	83.8%
4-Nitroaniline	--	2500 - 5900	2500	97.3%

Table 7-1: Nondetect Values Above Human Health Screening Criteria

Chemical	Screening Criteria[a]	Reporting Limit	RL Required[b]	FOE
4-Nitrophenol	--	2500 - 5900	2500	97.3%
Acenaphthene	3.68E+06	25 - 51	25	91.9%
Acenaphthylene	--	25 - 51	25	91.9%
Acetone	1.57E+06	92 - 130	100	70.3%
Anthracene	2.19E+07	25 - 32	25	91.7%
Benzene	6.01E+02	4.6 - 6.4	5	83.8%
Benzo(a)Anthracene	6.21E+02	25 - 32	25	93.3%
Benzo(a)pyrene	6.21E+01	25 - 32	25	93.9%
Benzo(b)Fluoranthene	6.21E+02	25 - 32	25	93.8%
Benzo(g,h,I)Perylene	--	25 - 32	25	93.9%
Benzo(k)Fluoranthene	3.78E+02	25 - 32	25	93.9%
bis(2-Chloroethoxy) Methane	--	510 - 1200	500	100.0%
bis(2-Chloroethyl) Ether	2.11E+02	170 - 380	163	100.0%
bis(2-Ethylhexyl) Phthalate	3.47E+04	510 - 1200	500	100.0%
Bromodichloromethane	8.24E+02	4.6 - 6.4	5	83.8%
Bromoform	6.16E+04	4.6 - 6.4	5	83.8%
Bromomethane	3.90E+03	4.6 - 6.4	5	83.8%
Butylbenzylphthalate	1.22E+07	510 - 1200	500	100.0%
Carbazole	2.43E+04	510 - 1200	500	100.0%
Carbon Disulfide	3.55E+05	4.6 - 6.4	5	83.8%
Carbon Tetrachloride	2.51E+02	4.6 - 6.4	5	83.8%
Chlorobenzene	1.51E+05	4.6 - 6.4	5	83.8%
Chloroethane	3.03E+03	4.6 - 6.4	5	83.8%
Chloroform	9.41E+02	4.6 - 6.4	5	83.8%
Chloromethane	1.23E+03	4.6 - 6.4	5	83.8%
Chrysene	3.78E+03	25 - 32	25	93.9%
cis-1,2-Dichloroethene	4.29E+04	4.6 - 6.4	5	83.8%
cis-1,3-Dichloropropene	--	4.6 - 6.4	5	83.8%
Dibenz(a,h)Anthracene	6.21E+01	25 - 32	25	91.7%
Dibenzofuran	2.91E+05	510 - 1200	500	100.0%
Dibromochloromethane	1.11E+03	4.6 - 6.4	5	83.8%
Dichlorodifluoromethane	9.39E+04	4.6 - 6.4	5	83.8%
Diethylphthalate	4.89E+07	510 - 1200	500	100.0%
Di-Isopropyl Ether	--	4.6 - 6.4	5	83.8%
Dimethylphthalate	1.00E+08	510 - 1200	500	100.0%
di-N-Butylphthalate	6.11E+06	510 - 1200	500	100.0%
di-N-Octylphthalate	2.44E+06	510 - 1200	500	100.0%
Ethyl Benzene	8.92E+03	4.6 - 6.4	5	83.8%
Ethyl Tertiary Butyl Ether	--	4.6 - 6.4	5	83.8%
Fluoranthene	2.29E+06	25 - 32	25	93.8%
Fluorene	2.75E+06	25 - 51	25	91.9%
Hexachlorbenzene	3.04E+02	510 - 1200	500	100.0%
Hexachlorobutadiene	6.24E+03	510 - 1200	500	100.0%
Hexachlorocyclopentadiene	3.65E+05	2500 - 5900	500	100.0%
Hexachloroethane	3.47E+04	510 - 1200	500	100.0%
indeno(1,2,3-c,d)Pyrene	6.21E+02	25 - 32	25	91.4%
Isophorone	5.12E+05	510 - 1200	500	100.0%
Methyl tert-Butyl Ether	1.67E+04	4.6 - 6.4	5	83.8%
Methylene Chloride	9.11E+03	4.6 - 6.4	5	83.8%
Naphthalene	5.59E+04	25 - 51	25	91.9%
Nitrobenzene	1.96E+04	510 - 1200	500	100.0%
N-Nitrosodi-N-Propylamine	6.95E+01	29 - 68	25	100.0%

Table 7-1: Nondetect Values Above Human Health Screening Criteria

Chemical	Screening Criteria[a]	Reporting Limit	RL Required[b]	FOE
N-Nitroso-Diphenylamine	9.93E+04	2500 - 5900	2500	97.3%
Pentachlorophenol	2.98E+03	1700 - 4000	1700	97.3%
Phenanthrene	--	25 - 32	25	91.4%
Phenol	3.67E+07	510 - 1000	500	100.0%
Pyrene	2.32E+06	25 - 32	25	93.8%
Styrene	1.70E+06	4.6 - 6.4	5	83.8%
Tertiary Amyl Methyl Ether	--	4.6 - 6.4	5	83.8%
Tertiary Butyl Alcohol	--	18 - 26	20	83.8%
Tetrachloroethene	1.51E+03	4.6 - 6.4	5	83.8%
Toluene	5.20E+05	4.6 - 6.4	5	83.8%
trans-1,2-Dichloroethene	6.95E+04	4.6 - 6.4	5	83.8%
trans-1,3-dichloropropene	--	4.6 - 6.4	5	83.8%
Trichloroethene	5.30E+01	4.6 - 6.4	5	83.8%
Trichlorofluoromethane	--	4.6 - 6.4	5	83.8%
Vinyl Chloride	--	4.6 - 6.4	5	83.8%
Xylenes, Total	2.75E+05	14 - 19	15	81.1%
Vinyl Chloride	--	4.6 - 6.4	5	83.8%
Xylenes, Total	2.75E+05	14 - 19	15	81.1%
Subsurface Soil (mg/kg)				
Antimony	3.06E+00	10.5 - 11.4	3	100.0%
Berylium	6.69E-01	0.215 - 0.459	0.2	100.0%
Cadmium	2.35E+00	1.05 - 1.14	0.2	100.0%
Nickel	1.53E+01	2.14 - 2.14	0.2	100.0%
PHC as Diesel Fuel	1.00E+01	10.7 - 11	10	100.0%
PHC as Gasoline	1.00E+01	9.99 - 30.1	10	90.0%
Selenium	3.20E-01	1.05 - 1.14	0.3	100.0%
Silver	5.39E-01	2.1 - 2.29	0.5	100.0%
Thallium	4.20E-01	1.05 - 1.32	0.4	100.0%
Subsurface Soil (pg/g)				
1,2,3,4,6,7,8-HpCDF	--	1.7 - 2.7	2.5	50.0%
2,3,7,8-TCDD	3.90E+00	0.78 - 0.79	0.5	100.0%
2,3,7,8-TCDF	--	0.42 - 0.66	0.5	50.0%
Total 2,3,7,8-TCDD	3.90E+00	0.78 - 0.79	0.5	100.0%
Subsurface Soil (ug/kg)				
1,1,1-Trichloroethane	1.20E+06	5 - 16	5	90.0%
1,1,2,2-Tetrachloroethane	4.08E+02	5 - 16	5	90.0%
1,1,2-Trichloroethane	7.29E+02	5 - 16	5	90.0%
1,1-Dichloroethane	2.79E+03	5 - 16	5	90.0%
1,1-Dichloroethene	1.24E+05	5 - 16	5	90.0%
1,2,4-Trichlorobenzene	6.50E+05	350 - 21000	500	50.0%
1,2-Dichlorobenzene	3.70E+05	350 - 21000	500	50.0%
1,2-Dichloroethane	2.78E+02	5 - 16	5	90.0%
1,2-Dichlorpropane	3.42E+02	5 - 16	5	90.0%
1,3-Dichlrobenzene	1.59E+04	350 - 21000	500	50.0%
1,4-Dichlorobenzene	3.45E+03	350 - 21000	500	50.0%
2,4,5-Trichlorophenol	6.11E+06	880 - 52000	500	100.0%
2,4,6-Trichlorophenol	6.95E+03	350 - 21000	500	50.0%
2,4-Dichlorophenol	1.83E+05	350 - 21000	500	50.0%
2,4-Dimethylphenol	1.22E+06	350 - 21000	500	50.0%
2,4-Dinitrotoluene	1.22E+05	350 - 21000	500	50.0%
2,6-Dinitrotoluene	6.11E+04	350 - 21000	500	50.0%
2.4-Dinitrophenol	1.22E+05	880 - 52000	2500	50.0%

Table 7-1: Nondetect Values Above Human Health Screening Criteria

Chemical	Screening Criteria[a]	Reporting Limit	RL Required[b]	FOE
2-Butanone	7.33E+06	50 - 160	100	20.0%
2-Chloroethyl vinyl ether	--	50 - 160	50	90.0%
2-Chloronaphthalene	4.94E+06	350 - 21000	500	50.0%
2-Chlorophenol	6.34E+04	350 - 21000	500	50.0%
2-Hexanone	--	50 - 160	50	90.0%
2-Methyl-4,6-Dinitrophenol	--	880 - 52000	2500	50.0%
2-Methylnaphthalene	--	350 - 21000	500	50.0%
o-Cresol	--	350 - 21000	500	50.0%
2-Nitroaniline	1.75E+03	880 - 52000	2500	50.0%
2-Nitrophenol	--	350 - 21000	500	50.0%
3,3'-Dichlorobenzene	1.08E+03	350 - 21000	500	50.0%
(M/P-Cresol	--	350 - 21000	500	50.0%
3-Nitroaniline	--	880 - 52000	2500	50.0%
4-bromophenyl-phenylether	--	350 - 21000	500	50.0%
4-Chloro-3-Methylphenol	--	350 - 21000	500	50.0%
4-Chloroaniline	2.44E+05	350 - 21000	1000	50.0%
4-Chlorophenyl-phenyl ether	--	350 - 21000	500	50.0%
4-Methyl-2-pentanone	7.87E+05	50 - 160	50	90.0%
4-Nitroaniline	--	880 - 52000	2500	50.0%
4-Nitrophenol	--	880 - 52000	2500	50.0%
Acenaphthene	3.68E+06	350 - 21000	500	50.0%
Acenaphthylene	--	350 - 21000	500	50.0%
Acetone	1.57E+06	53 - 160	100	50.0%
Anthracene	2.19E+07	350 - 21000	500	50.0%
Benzene	6.01E+02	5 - 16	5	88.9%
Benzo(a)Anthracene	6.21E+02	350 - 21000	500	55.6%
Benzo(a)pyrene	6.21E+01	35 - 16000	25	100.0%
Benzo(b)Fluoranthene	6.21E+02	350 - 21000	500	55.6%
Benzo(g,h,l)Perylene	--	350 - 21000	500	50.0%
Benzo(k)Fluoranthene	3.78E+02	350 - 21000	500	50.0%
Bis (2-chloroisopropyl)ether	2.88E+03	350 - 21000	500	50.0%
bis(2-Chloroethoxy) Methane	--	350 - 21000	500	50.0%
bis(2-Chloroethyl) Ether	2.11E+02	35 - 21000	163	70.0%
bis(2-Ethylhexyl) Phthalate	3.47E+04	350 - 21000	500	50.0%
Bromodichloromethane	8.24E+02	5 - 16	5	90.0%
Bromoform	6.16E+04	5 - 16	5	90.0%
Bromomethane	3.90E+03	5 - 16	5	90.0%
Butylbenzylphthalate	1.22E+07	350 - 21000	500	50.0%
Carbon Disulfide	3.55E+05	5 - 16	5	90.0%
Carbon Tetrachloride	2.51E+02	5 - 16	5	90.0%
Chlorobenzene	1.51E+05	5 - 16	5	90.0%
Chloroethane	3.03E+03	5 - 16	5	90.0%
Chloroform	9.41E+02	5 - 16	5	90.0%
Chloromethane	1.23E+03	5 - 16	5	90.0%
Chrysene	3.78E+03	350 - 21000	500	55.6%
cis-1,2-Dichloroethene	4.29E+04	5 - 16	5	90.0%
cis-1,3-Dichloropropene	--	5 - 16	5	90.0%
Dibenz(a,h)Anthracene	6.21E+01	35 - 16000	25	100.0%
Dibenzofuran	2.91E+05	350 - 21000	500	50.0%
Dibromochloromethane	1.11E+03	5 - 16	5	90.0%
Diethylphthalate	4.89E+07	360 - 21000	500	62.5%
Dimethylphthalate	1.00E+08	350 - 21000	500	50.0%

Table 7-1: Nondetect Values Above Human Health Screening Criteria

Chemical	Screening Criteria[a]	Reporting Limit	RL Required[b]	FOE
di-N-Butylphthalate	6.11E+06	350 - 21000	500	50.0%
di-N-Octylphthalate	2.44E+06	350 - 21000	500	50.0%
Ethyl Benzene	8.92E+03	5 - 16	5	90.0%
Fluoranthene	2.29E+06	350 - 21000	500	55.6%
Fluorene	2.75E+06	350 - 21000	500	50.0%
Hexachlorbenzene	3.04E+02	35-21000	500	44.4%
Hexachlorobutadiene	6.24E+03	350 - 21000	500	50.0%
Hexachlorocyclopentadiene	3.65E+05	350 - 21000	500	50.0%
Hexachloroethane	3.47E+04	350 - 21000	500	50.0%
indeno(1,2,3-c,d)Pyrene	6.21E+02	35 - 21000	500	44.4%
Methyl tert-Butyl Ether	1.67E+04	9.9 - 32	5	100.0%
Methylene Chloride	9.11E+03	5 - 16	5	88.9%
Naphthalene	5.59E+04	350 - 21000	500	50.0%
Nitrobenzene	1.96E+04	350 - 21000	500	50.0%
N-Nitrosodi-N-Propylamine	6.95E+01	35 - 16000	25	100.0%
N-Nitroso-Diphenylamine	9.93E+04	350 - 21000	2500	10.0%
Pentachlorophenol	2.98E+03	180 - 21000	1700	40.0%
Phenanthrene	--	350 - 21000	500	55.6%
Phenol	3.67E+07	350 - 21000	500	50.0%
Pyrene	2.32E+06	350 - 21000	500	55.6%
Styrene	1.70E+06	5 - 16	5	90.0%
Tetrachloroethene	1.51E+03	5 - 16	5	90.0%
Toluene	5.20E+05	5 - 16	5	90.0%
trans-1,2-Dichloroethene	6.95E+04	5 - 16	5	90.0%
trans-1,3-dichloropropene	--	5 - 16	5	90.0%
Trichloroethene	5.30E+01	5 - 16	5	90.0%
Vinyl Acetate	4.26E+05	50 - 160	50	90.0%
Vinyl Chloride	--	5 - 16	5	90.0%
Xylenes, Total	2.75E+05	5 - 16	15	10.0%
Groundwater (ug/l)				
PHC as Motor Oil PRG MCL	1.00E+03	96 - 100000	1	27.3%
2.4-Dinitrophenol 73 -	7.30E+01 PRG	48 - 50	10	100.0%
4-Chloroaniline 150 -	1.46E+02 PRG	19 - 20	10	100.0%
Antimony 15 6	1.50E+01 PRG	1.8 - 60	10	50.0%
Arsenic .045 10	4.50E-02 PRG	4.5 - 12	2	100.0%
Berylium 73 4	7.30E+01 PRG	5 - 5	2	100.0%
Cobalt 730 -	2.20E+03 PRG	0.36 - 50	5	8.3%
Iron -	1.10E+04 PRG	28.5 - 79.1	50	25.0%
Nickel 730 -	4.10E+04 PRG	2.9 - 5.2	5	25.0%
Thallium 2.4 2	2.40E+00 PRG	6.6 - 10	2.4	100.0%
Zinc 11,000 -	1.10E+04 PRG	9 - 11.4	10	75.0%

NOTES:

mg/kg = milligrams per kilogram

ug/kg = microgram per kilogram

pg/g = picogram per kilogram

% = percent

[a] Unless otherwise noted, the soil screening criteria are equivalent to EPA Region IX (2002) residential preliminary remediation goals, and water screening criteria are equivalent to federal maximum contaminant levels (EPA 2001).

[b] Reporting limit of nondetect values.

FOE = Frequency of exceedance; percentage of times RL of nondetect exceeds screening criteria.

-- = No EPA Region IX (2002) or Federal Maximum Contaminant Level available.

7.2.3.3 SUMMARY STATISTICS FOR SAMPLE DATA

Assuming that the data sets are log-normally distributed (EPA 1992b), the 95 percent UCL of the arithmetic mean was estimated. Summary statistics for surface soil data (e.g., frequency of detection, minimum and maximum values) were used for general data review and also to make the UCL calculations (Table 7-2). Summary statistics for subsurface soil data (e.g., frequency of detection, minimum and maximum values) used for general data review and also to make the UCL calculations (Table 7-3).

7.2.3.4 ANALYTICAL METHODOLOGY

All methods used were appropriate for risk assessment purposes as defined by the EPA and the approved work plan.

7.3 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Analytes expected to be characteristic of releases during debris placement were used to identify COPCs. The chemical groups included metals, VOCs, SVOCs, dioxins/furans, and petroleum hydrocarbons. As such, the work plan proposed a comprehensive list of chemicals for testing (Earth Tech 2002a). From all data derived from the analyses, all usable (non-rejected) contaminants detected at least once in an environmental medium (i.e., soil or groundwater) were considered COPCs for the screening PRE. The selection of COPCs followed a tiered approach as outlined in DoN (2001).

In order to determine whether the COPCs should be further evaluated in the PRE, maximum and RME EPCs are compared to EPA Region IX residential and industrial soil PRGs. COPCs having EPCs greater than the screening criteria are then retained for further evaluation in the SSPRE to determine the magnitude of exposure associated with excess cancer risk or noncancer hazard.

7.3.1 Essential Nutrients

Constituents such as calcium, magnesium, potassium, and sodium are referred to as essential nutrients. These chemicals do not have toxicity criteria or PRGs, and are generally considered to be of minor, if any, concern in risk assessments performed for hazardous waste site remedial activities. While these essential nutrients were not evaluated in this report, they have been summarized and presented for information purposes in subsequent risk summary tables.

7.3.2 Summary of COPCs by Media for Each Site

All chemicals detected in surface soil (0 to 1 feet bgs) and subsurface soils (greater than 1 to 10 feet bgs) were retained as COPCs for the human health screening PRE. A summary of the COPCs that were evaluated for each soil stratum is provided below.

7.3.2.1 SURFACE AND SUBSURFACE SOIL

TPH, TCDD, polynuclear aromatic hydrocarbons (PAHs), and inorganic chemicals were detected in surface soil samples collected at the site. All of the above chemicals or classes were detected in subsurface soils with the addition of three VOCs at relatively low concentrations.

7.3.2.2 GROUNDWATER

Chemicals detected in groundwater were dominated by inorganic elements. Some organic chemicals (semivolatiles such as diethylphthalate, m/p-creosol, and phenol, TPHs, and chloroform) were detected as well.

7.3.3 Chemicals Without Toxicity Values

The SPRE compares COPCs to PRGs. The EPA develops PRGs based on cancer risk and/or noncancer hazard toxicity values (i.e., cancer slope factors and/or reference doses). Most of the chemicals that have been detected and are noted as COPCs have such toxicity values. However, some of those chemicals detected do not have PRGs. Chemicals from the current data that do not have PRGs due to lack of toxicity values are listed below:

- 2-methylnaphthylene
- benzo(g,h,i)perylene
- phenanthrene
- TPH

While the lack of toxicity values for the above COPCs imparts additional uncertainty into the PRE, overall the degree of uncertainty affecting the risk assessment results is minimal. This uncertainty is discussed in Section 7.7, Uncertainty Analysis.

7.4 Exposure Assessment

The exposure assessment section identifies land use and receptors that currently, or in the future, are likely to use the property and, as a result, may contact COPCs identified in the previous sections.

7.4.1 Land Use and Receptors

Previous land use at the site was industrial. The Wherry Housing Area is located to the northeast and south of AA 3 and consists of single-family residences. However, since the operational closing of MCAS El Toro, the Wherry Housing Area is no longer used. The site is currently fenced along the northwest and southwest sides, with vegetation surrounding the remainder of the site. Authorized visitors and escorts are the only current human receptors on the site. Even though the reuse for the site is not finalized, the preliminary reuse scenario proposed for AA 3 and surrounding areas is residential use. Therefore, potential future human receptors at AA 3 include residents, industrial workers, construction workers, agricultural workers, and recreational users. In summary, human receptors noted in Figure 7-1 for consideration are as follows:

- Residents
- Current construction/industrial (C/I) workers and escorted visitors
- Current offsite agricultural workers
- Future offsite agricultural workers
- Future C/I workers
- Onsite recreational users

7.4.2 Conceptual Site Model

The CSM is used to guide the evaluation of potential exposures so that relevant pathways, exposure routes, and ultimately risk can be evaluated in the PRE. The CSM schematically identifies chemical source areas, chemical release mechanisms, environmental transport media and processes, potential exposure points and routes, and potential receptors.

Table 7-2: Summary Statistics for Analytical Data from Surface Soil (0 feet –1 feet bgs) Samples

EPA Method	Analyte	Units	No. of Detects	No. of Samples	Frequency of Detects (%)	Maximum Detect Concentration	Mean (Ln)	Standard Deviation (Ln)	95% UCL Concentrations	RME EPC Concentrations	Flag	H-Statistic
6010B	Aluminum	mg/kg	33	33	100%	1.58E+04	9.07E+00	3.30E-01	1.02E+04	1.02E+04		1.81
6010B	Antimony	mg/kg	1	33	3%	2.10E+00	-1.25E+00	1.33E+00	5.71E+02	2.10E+00	X	8.76
6010B	Arsenic	mg/kg	33	33	100%	4.60E+00	1.05E+00	2.50E-01	3.19E+00	3.19E+00		1.76
6010B	Barium	mg/kg	33	33	100%	1.87E+02	4.56E+00	2.60E-01	1.08E+02	1.08E+02		1.77
6010B	Berylium	mg/kg	10	33	30%	3.10E-01	-2.35E+00	8.60E-01	1.93E-01	1.93E-01		2.25
6010B	Cadmium	mg/kg	33	33	100%	1.00E+00	-5.80E-01	4.60E-01	7.28E-01	7.28E-01		1.89
6010B	Calcium	mg/kg	33	33	100%	2.52E+04	8.40E+00	5.20E-01	6.05E+03	6.05E+03		1.94
6010B	Chromium	mg/kg	33	33	100%	1.58E+01	2.28E+00	2.80E-01	1.11E+01	1.11E+01		1.78
6010B	Cobalt	mg/kg	33	33	100%	7.60E+00	1.52E+00	2.60E-01	5.12E+00	5.12E+00		1.77
6010B	Copper	mg/kg	33	33	100%	1.08E+01	1.74E+00	3.90E-01	6.95E+00	6.95E+00		1.84
6010B	Iron	mg/kg	33	33	100%	1.94E+04	9.32E+00	2.70E-01	1.26E+04	1.26E+04		1.77
6010B	Lead	mg/kg	33	33	100%	2.07E+01	1.73E+00	6.60E-01	8.88E+00	8.88E+00		2.06
6010B	Magnesium	mg/kg	33	33	100%	6.90E+03	8.26E+00	3.10E-01	4.46E+03	4.46E+03		1.8
6010B	Manganese	mg/kg	33	33	100%	2.89E+02	5.20E+00	2.20E-01	1.98E+02	1.98E+02		1.75
6010B	Nickel	mg/kg	33	33	100%	1.21E+01	1.94E+00	2.60E-01	7.79E+00	7.79E+00		1.77
6010B	Potassium	mg/kg	33	33	100%	3.97E+03	7.76E+00	3.00E-01	2.70E+03	2.70E+03		1.79
6010B	Selenium	mg/kg	20	33	61%	1.10E+00	-8.00E-01	3.60E-01	5.42E-01	5.42E-01		1.83
6010B	Silver	mg/kg	1	33	3%	2.00E+00	-5.60E-01	2.40E-01	6.32E-01	6.32E-01		1.76
6010B	Sodium	mg/kg	0	33	0%	–	4.26E+00	9.40E-01	1.64E+02	–	X	2.34
6010B	Thallium	mg/kg	0	33	0%	–	-8.20E-01	6.00E-02	4.51E-01	–	X	1.59
6010B	Vanadium	mg/kg	33	33	100%	4.41E+01	3.23E+00	2.60E-01	2.84E+01	2.84E+01		1.77
6010B	Zinc	mg/kg	33	33	100%	5.71E+01	3.49E+00	3.20E-01	3.81E+01	3.81E+01		1.8
7471A	Mercury	mg/kg	33	33	100%	6.90E-02	-3.70E+00	4.10E-01	3.08E-02	3.08E-02		1.86
8015B DRO	PHC as Diesel Fuel	mg/kg	14	33	42%	1.50E+01	1.36E+00	6.80E-01	6.28E+00	6.28E+00		2.07
8015B DRO	PHC as Motor Oil	mg/kg	20	33	61%	1.60E+02	2.34E+00	9.70E-01	2.48E+01	2.48E+01		2.37
8015B GRO	PHC as Gasoline	mg/kg	26	33	79%	2.77E+00	-3.30E+00	9.40E-01	9.07E-02	9.07E-02		2.41
8260B	2-Butanone	ug/kg	0	33	0%	–	4.01E+00	8.00E-02	5.65E+01	–	X	1.64
8260B	Acetone	ug/kg	0	33	0%	–	4.01E+00	8.00E-02	5.65E+01	–	X	1.64
8260B	Benzene	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Chloroform	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Methylene Chloride	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Styrene	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	1,1,1,2-Tetrachloroethane	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	1,1,1-Trichloroethane	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	1,1,2,2-Tetrachloroethane	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	1,1,2-Trichloroethane	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	1,1,2-Trichlorotrifluoroethane	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	1,1,-Dichloroethane	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	1,1,-Dichloroethene	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	1,2,3-Trichloropropane	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	1,2-Dichloroethane	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	1,2-Dichlorotetrafluoroethane	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62

Table 7-2: Summary Statistics for Analytical Data from Surface Soil (0 feet –1 feet bgs) Samples

EPA Method	Analyte	Units	No. of Detects	No. of Samples	Frequency of Detects (%)	Maximum Detect Concentration	Mean (Ln)	Standard Deviation (Ln)	95% UCL Concentrations	RME EPC Concentrations	Flag	H-Statistic
8260B	1,2-Dichlorpropane	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	2-Hexanone	ug/kg	0	33	0%	–	3.31E+00	7.00E-02	2.82E+01	–	X	1.62
8260B	4-Methyl-2-pentanone	ug/kg	0	33	0%	–	3.31E+00	7.00E-02	2.82E+01	–	X	1.62
8260B	Bromodichloromethane	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Bromoform	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Bromomethane	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Carbon Disulfide	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Carbon Tetrachloride	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Chlorobenzene	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Chloroethane	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Chloromethane	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	cis-1,2-Dichloroethene	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	cis-1,3-Dichloropropene	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Dibromochloromethane	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Dichlorodifluoromethane	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Di-Isopropyl Ether	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Ethyl Benzene	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Ethyl Tertiary Butyl Ether	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Methyl tert-Butyl Ether	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Tertiary Amyl Methyl Ether	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Tertiary Butyl Alcohol	ug/kg	0	33	0%	–	2.40E+00	7.00E-02	1.13E+01	–	X	1.61
8260B	Tetrachloroethene	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Toluene	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	trans-1,2-Dichloroethene	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	trans-1,3-dichloropropene	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Trichloroethene	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Trichlorofluoromethane	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Vinyl Chloride	ug/kg	0	33	0%	–	1.01E+00	7.00E-02	2.82E+00	–	X	1.62
8260B	Xylenes, Total	ug/kg	0	33	0%	–	2.12E+00	7.00E-02	8.50E+00	–	X	1.62
8270C	M/P-Cresol	ug/kg	0	33	0%	–	5.71E+00	2.20E-01	3.29E+02	–	X	1.75
8270C	bis(2-Ethylhexyl) Phthalate	ug/kg	3	33	9%	7.00E+01	4.12E+00	1.70E-01	8.79E+01	7.00E+01	X	2.94
8270C	Diethylphthalate	ug/kg	1	33	3%	2.25E+02	–	–	–	2.25E+02		
8270C	Hexachlorbenzene	ug/kg	0	33	0%	–	5.71E+00	2.20E-01	3.29E+02	–	X	1.75
8270C	Phenol	ug/kg	12	33	36%	9.36E+02	5.72E+00	4.50E-01	3.90E+02	3.90E+02		1.88
8270C	1,2,4-Trichlorobenzene	ug/kg	0	33	0%	–	5.71E+00	2.20E-01	3.29E+02	–	X	1.75
8270C	1,2-Dichlorobenzene	ug/kg	0	33	0%	–	5.71E+00	2.20E-01	3.29E+02	–	X	1.75
8270C	1,3-Dichlrobenzene	ug/kg	0	33	0%	–	5.71E+00	2.20E-01	3.29E+02	–	X	1.75
8270C	1,4-Dichlorobenzene	ug/kg	0	33	0%	–	5.71E+00	2.20E-01	3.29E+02	–	X	1.75
8270C	2,2'-oxybis(1-Chloropropane)	ug/kg	0	33	0%	–	5.71E+00	2.20E-01	3.29E+02	–	X	1.75
8270C	2,4,5-Trichlorophenol	ug/kg	0	33	0%	–	5.71E+00	2.20E-01	3.29E+02	–	X	1.75
8270C	2,4,6-Trichlorophenol	ug/kg	0	33	0%	–	5.71E+00	2.20E-01	3.29E+02	–	X	1.75
8270C	2,4-Dichlorophenol	ug/kg	0	33	0%	–	5.71E+00	2.20E-01	3.29E+02	–	X	1.75

Table 7-2: Summary Statistics for Analytical Data from Surface Soil (0 feet –1 feet bgs) Samples

EPA Method	Analyte	Units	No. of Detects	No. of Samples	Frequency of Detects (%)	Maximum Detect Concentration	Mean (Ln)	Standard Deviation (Ln)	95% UCL Concentrations	RME EPC Concentrations	Flag	H-Statistic
8270C	2,4-Dimethylphenol	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	2,4-Dinitrotoluene	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	2,6-Dinitrotoluene	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	2.4-Dinitrophenol	ug/kg	0	33	0%	--	7.32E+00	2.20E-01	1.65E+03	--	X	1.75
8270C	2-Chloronaphthalene	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	2-Chlorophenol	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	2-Methyl-4,6-Dinitrophenol	ug/kg	0	33	0%	--	7.32E+00	2.20E-01	1.65E+03	--	X	1.75
8270C	o-Cresol	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	2-Nitroaniline	ug/kg	0	33	0%	--	7.32E+00	2.20E-01	1.65E+03	--	X	1.75
8270C	2-Nitrophenol	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	3,3'-Dichlorobenzene	ug/kg	0	33	0%	--	6.40E+00	2.30E-01	6.60E+02	--	X	1.75
8270C	3-Nitroaniline	ug/kg	0	33	0%	--	7.32E+00	2.20E-01	1.65E+03	--	X	1.75
8270C	4-bromophenyl-phenylethether	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	4-Chloro-3-Methylphenol	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	4-Chloroaniline	ug/kg	0	33	0%	--	6.40E+00	2.30E-01	6.60E+02	--	X	1.75
8270C	4-Chlorophenyl-phenyl ether	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	4-Nitroaniline	ug/kg	0	33	0%	--	7.32E+00	2.20E-01	1.65E+03	--	X	1.75
8270C	4-Nitrophenol	ug/kg	0	33	0%	--	7.32E+00	2.20E-01	1.65E+03	--	X	1.75
8270C	bis(2-Chloroethoxy) Methane	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	bis(2-Chloroethyl) Ether	ug/kg	0	33	0%	--	4.59E+00	2.20E-01	1.08E+02	--	X	1.75
8270C	Butylbenzylphthalate	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	Carbazone	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	Dibenzofuran	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	Dimethylphthalate	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	di-N-Butylphthalate	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	di-N-Octylphthalate	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	Hexachlorobutadiene	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	Hexachlorocyclopentadiene	ug/kg	0	33	0%	--	7.32E+00	2.20E-01	1.65E+03	--	X	1.75
8270C	Hexachloroethane	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	Isophorone	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	Nitrobenzene	ug/kg	0	33	0%	--	5.71E+00	2.20E-01	3.29E+02	--	X	1.75
8270C	N-Nitrosodi-N-Propylamine	ug/kg	0	33	0%	--	2.86E+00	2.20E-01	1.91E+01	--	X	1.75
8270C	N-Nitroso-Diphenylamine	ug/kg	0	33	0%	--	7.32E+00	2.20E-01	1.65E+03	--	X	1.75
8270C	Pentachlorophenol	ug/kg	0	33	0%	--	6.93E+00	2.20E-01	1.13E+03	--	X	1.75
PAH-SIM	Anthracene	ug/kg	1	33	3%	4.40E+01	2.66E+00	2.10E-01	1.56E+01	1.56E+01		1.74
PAH-SIM	Benzo(a)Anthracene	ug/kg	7	33	21%	7.30E+02	2.74E+00	7.10E-01	2.60E+01	2.60E+01		2.1
PAH-SIM	Benzo(a)pyrene	ug/kg	4	33	12%	1.03E+03	2.75E+00	7.60E-01	2.77E+01	2.77E+01		2.15
PAH-SIM	Benzo(b)Fluoranthene	ug/kg	5	33	15%	1.79E+03	2.79E+00	8.70E-01	3.36E+01	3.36E+01		2.26
PAH-SIM	Benzo(g,h,I)Perylene	ug/kg	4	33	12%	4.40E+02	2.71E+00	6.20E-01	2.28E+01	2.28E+01		2.02
PAH-SIM	Benzo(k)Fluoranthene	ug/kg	4	33	12%	5.10E+02	2.71E+00	6.50E-01	2.34E+01	2.34E+01		2.04
PAH-SIM	Chrysene	ug/kg	4	33	12%	8.70E+02	2.74E+00	7.40E-01	2.70E+01	2.70E+01		2.13
PAH-SIM	Dibenz(a,h)Anthracene	ug/kg	1	33	3%	9.70E+01	2.69E+00	3.50E-01	1.74E+01	1.74E+01		1.82

Table 7-2: Summary Statistics for Analytical Data from Surface Soil (0 feet –1 feet bgs) Samples

EPA Method	Analyte	Units	No. of Detects	No. of Samples	Frequency of Detects (%)	Maximum Detect Concentration	Mean (Ln)	Standard Deviation (Ln)	95% UCL Concentrations	RME EPC Concentrations	Flag	H-Statistic
PAH-SIM	Fluoranthene	ug/kg	5	33	15%	1.00E+03	2.74E+00	7.60E-01	2.75E+01	2.75E+01		2.15
PAH-SIM	indeno(1,2,3-c,d)Pyrene	ug/kg	2	33	6%	4.60E+02	2.74E+00	6.10E-01	2.32E+01	2.32E+01		2.01
PAH-SIM	Phenanthrene	ug/kg	2	33	6%	2.90E+02	2.70E+00	5.40E-01	2.09E+01	2.09E+01		1.95
PAH-SIM	Pyrene	ug/kg	5	33	15%	9.60E+02	2.76E+00	7.40E-01	2.75E+01	2.75E+01		2.13
PAH-SIM	2-Methylnaphthalene	ug/kg	0	33	0%	–	2.65E+00	1.20E-01	1.48E+01	–	X	1.71
PAH-SIM	Acenaphthene	ug/kg	0	33	0%	–	2.65E+00	1.20E-01	1.48E+01	–	X	1.71
PAH-SIM	Acenaphthylene	ug/kg	0	33	0%	–	2.65E+00	1.20E-01	1.48E+01	–	X	1.71
PAH-SIM	Fluorene	ug/kg	0	33	0%	–	2.65E+00	1.20E-01	1.48E+01	–	X	1.71
PAH-SIM	Naphthalene	ug/kg	0	33	0%	–	2.65E+00	1.20E-01	1.48E+01	–	X	1.71
8290	Total 2,3,7,8-TCDD	pg/g	9	9	100%	1.84E+01	-2.00E-01	1.29E+00	1.14E+01	1.14E+01		3.93
8290	Total 2,3,7,8-TCDD Bird	pg/g	9	9	100%	3.53E+01	8.00E-02	1.40E+00	2.26E+01	2.26E+01		4.18
8290	Total 2,3,7,8-TCDD Fish	pg/g	9	9	100%	1.82E+01	-1.90E-01	1.28E+00	1.08E+01	1.08E+01		3.89
8290	Total 2,3,7,8-TCDD Mammal	pg/g	9	9	100%	1.84E+01	-2.00E-01	1.29E+00	1.14E+01	1.14E+01		3.93

NOTES:
RME = reasonable maximum exposure
EPC = exposure point concentrations
UCL = upper confidence limit
ln = natural logarithm
mg/kg = milligrams per kilogram
ug/kg = microgram per kilogram
pg/g = picogram per kilogram
% = percent
– = not applicable
Cross mark in the Flag column indicates that the RME EPC for that analyte is the maximum concentration, since 95% UCL value is grater than the maximum concentrations.

Table 7-3: Summary Statistics for Analytical Data from Subsurface Soil (> 1 feet – 10 feet bgs) Samples

EPA Method	Analyte	Unit	No. of Detects	No. of Samples	Frequency of Detects (%)	Maximum Detect Concentration	Mean (Ln)	Standard Deviation (Ln)	95% UCL Concentrations	RME EPC Concentrations	Flag	H-Statistic
6010B	Antimony	mg/kg	0	9	0%	–	1.70E+00	3.00E-02	5.53E+00	–	X	1.52
6010B	Arsenic	mg/kg	9	9	100%	4.63E+00	1.10E+00	3.10E-01	3.93E+00	3.93E+00		2.03
6010B	Barium	mg/kg	9	9	100%	1.12E+02	4.46E+00	2.00E-01	1.00E+02	1.00E+02		1.9
6010B	Berylium	mg/kg	0	9	0%	–	-1.80E+00	2.90E-01	2.11E-01	–	X	2
6010B	Cadmium	mg/kg	0	9	0%	–	-6.10E-01	3.00E-02	5.53E-01	–	X	1.52
6010B	Chromium	mg/kg	9	9	100%	1.64E+01	2.31E+00	3.90E-01	1.46E+01	1.46E+01		2.12
6010B	Cobalt	mg/kg	9	9	100%	5.33E+00	1.33E+00	2.50E-01	4.62E+00	4.62E+00		1.96
6010B	Copper	mg/kg	9	9	100%	1.27E+01	1.94E+00	4.10E-01	1.04E+01	1.04E+01		2.15
6010B	Lead	mg/kg	9	9	100%	1.33E+01	1.78E+00	6.40E-01	1.29E+01	1.29E+01		2.52
6010B	Manganese	mg/kg	9	9	100%	2.32E+02	5.18E+00	2.30E-01	2.14E+02	2.14E+02		1.94
6010B	Molybdenum	mg/kg	0	9	0%	–	9.00E-02	3.00E-02	1.11E+00	–	X	1.52
6010B	Nickel	mg/kg	8	9	89%	1.37E+01	1.85E+00	7.40E-01	1.69E+01	1.37E+01	X	2.7
6010B	Selenium	mg/kg	0	9	0%	–	-6.10E-01	3.00E-02	5.53E-01	–	X	1.52
6010B	Silver	mg/kg	0	9	0%	–	9.00E-02	3.00E-02	1.11E+00	–	X	1.52
6010B	Thallium	mg/kg	0	9	0%	–	-5.80E-01	7.00E-02	5.88E-01	–	X	1.71
6010B	Vanadium	mg/kg	9	9	100%	3.56E+01	3.20E+00	2.60E-01	3.06E+01	3.06E+01		1.97
6010B	Zinc	mg/kg	9	9	100%	4.83E+01	3.59E+00	2.20E-01	4.31E+01	4.31E+01		1.93
7471A	Mercury	mg/kg	0	9	0%	–	-2.91E+00	3.00E-02	5.53E-02	–	X	1.52
8015B DRO	PHC as Diesel Fuel	mg/kg	6	9	67%	5.60E+03	3.68E+00	2.31E+00	1.20E+05	5.60E+03	X	6.53
8015B GRO	PHC as Gasoline	mg/kg	0	9	0%	–	1.98E+00	3.80E-01	1.04E+01	–	X	2.11
8260B	2-Butanone	mg/kg	0	9	0%	–	3.58E+00	4.00E-01	5.28E+01	–	X	2.14
8260B	Acetone	ug/kg	5	9	56%	1.00E+02	3.95E+00	4.50E-01	8.19E+01	8.19E+01		2.21
8260B	Benzene	ug/kg	1	9	11%	2.45E+00	–	–	–	2.45E+00		–
8260B	Chloroform	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	Methylene Chloride	ug/kg	1	9	11%	9.20E+00	1.37E+00	5.10E-01	6.81E+00	6.81E+00		2.3
8260B	Styrene	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	1,1,1-Trichloroethane	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	1,1,2,2-Tetrachloroethane	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	1,1,2-Trichloroethane	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	1,1,-Dichloroethane	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	1,1,-Dichloroethene	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	1,2-Dichloroethane	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	1,2-Dichlorpropane	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	2-Chloroethyl vinyl ether	ug/kg	0	9	0%	–	3.58E+00	4.00E-01	5.28E+01	–	X	2.14
8260B	2-Hexanone	ug/kg	0	9	0%	–	3.58E+00	4.00E-01	5.28E+01	–	X	2.14
8260B	4-Methyl-2-pentanone	ug/kg	0	9	0%	–	3.58E+00	4.00E-01	5.28E+01	–	X	2.14
8260B	Bromodichloromethane	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	Bromoform	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	Bromomethane	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14

Table 7-3: Summary Statistics for Analytical Data from Subsurface Soil (> 1 feet – 10 feet bgs) Samples

EPA Method	Analyte	Unit	No. of Detects	No. of Samples	Frequency of Detects (%)	Maximum Detect Concentration	Mean (Ln)	Standard Deviation (Ln)	95% UCL Concentrations	RME EPC Concentrations	Flag	H-Statistic
8260B	Carbon Disulfide	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	Carbon Tetrachloride	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	Chlorobenzene	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	Chloroethane	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	Chloromethane	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	cis-1,2-Dichloroethene	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	cis-1,3-Dichloropropene	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	Dibromochloromethane	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	Ethyl Benzene	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	Methyl tert-Butyl Ether	ug/kg	0	9	0%	–	1.98E+00	4.00E-01	1.06E+01	–	X	2.13
8260B	Tetrachloroethene	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	Toluene	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	trans-1,2-Dichloroethene	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	trans-1,3-dichloropropene	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	Trichloroethene	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	Vinyl Acetate	ug/kg	0	9	0%	–	3.58E+00	4.00E-01	5.28E+01	–	X	2.14
8260B	Vinyl Chloride	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8260B	Xylenes, Total	ug/kg	0	9	0%	–	1.28E+00	4.00E-01	5.28E+00	–	X	2.14
8270C	M/P-Cresol	ug/kg	0	9	0%	–	6.18E+00	1.39E+00	9.95E+03	–	X	4.17
8270C	Benzo(a)Anthracene	ug/kg	1	9	11%	2.70E+02	5.28E+00	1.80E-01	2.43E+02	2.43E+02		2.17
8270C	Benzo(a)pyrene	ug/kg	1	9	11%	2.30E+02	4.27E+00	1.10E+00	1.18E+03	2.30E+02	X	4.47
8270C	Benzo(b)Fluoranthene	ug/kg	1	9	11%	4.40E+02	5.38E+00	4.00E-01	3.96E+02	3.96E+02		2.65
8270C	bis(2-Ethylhexyl) Phthalate	ug/kg	0	9	0%	–	6.18E+00	1.39E+00	9.95E+03	–	X	4.17
8270C	Chrysene	ug/kg	1	9	11%	2.50E+02	5.26E+00	1.50E-01	2.28E+02	2.28E+02		2.11
8270C	Diethylphthalate	ug/kg	2	9	22%	2.60E+02	5.15E+00	3.60E-01	2.93E+02	2.60E+02	X	2.56
8270C	Fluoranthene	ug/kg	1	9	11%	6.00E+02	5.44E+00	5.40E-01	6.06E+02	6.00E+02	X	3.07
8270C	Hexachlorbenzene	ug/kg	1	9	11%	1.50E+02	3.42E+00	1.06E+00	4.06E+03	1.50E+02	X	7.06
8270C	indeno(1,2,3-c,d)Pyrene	ug/kg	1	9	11%	8.10E+01	3.40E+00	8.60E-01	3.39E+04	8.10E+01	X	10.93
8270C	Phenanthrene	ug/kg	1	9	11%	1.40E+02	–	–	–	1.40E+02		–
8270C	Phenol	ug/kg	0	9	0%	–	6.18E+00	1.39E+00	9.95E+03	–	X	4.17
8270C	Pyrene	ug/kg	1	9	11%	4.60E+02	5.39E+00	4.20E-01	4.19E+02	4.19E+02		2.7
8270C	1,2,4-Trichlorobenzene	ug/kg	0	9	0%	–	6.18E+00	1.39E+00	9.95E+03	–	X	4.17
8270C	1,2-Dichlorobenzene	ug/kg	0	9	0%	–	6.18E+00	1.39E+00	9.95E+03	–	X	4.17
8270C	1,3-Dichlrobenzene	ug/kg	0	9	0%	–	6.18E+00	1.39E+00	9.95E+03	–	X	4.17
8270C	1,4-Dichlorobenzene	ug/kg	0	9	0%	–	6.18E+00	1.39E+00	9.95E+03	–	X	4.17
8270C	2,4,5-Trichlorophenol	ug/kg	0	9	0%	–	7.10E+00	1.39E+00	2.45E+04	–	X	4.16
8270C	2,4,6-Trichlorophenol	ug/kg	0	9	0%	–	6.18E+00	1.39E+00	9.95E+03	–	X	4.17
8270C	2,4-Dichlorophenol	ug/kg	0	9	0%	–	6.18E+00	1.39E+00	9.95E+03	–	X	4.17
8270C	2,4-Dimethylphenol	ug/kg	0	9	0%	–	6.18E+00	1.39E+00	9.95E+03	–	X	4.17

Table 7-3: Summary Statistics for Analytical Data from Subsurface Soil (> 1 feet – 10 feet bgs) Samples

EPA Method	Analyte	Unit	No. of Detects	No. of Samples	Frequency of Detects (%)	Maximum Detect Concentration	Mean (Ln)	Standard Deviation (Ln)	95% UCL Concentrations	RME EPC Concentrations	Flag	H-Statistic
8270C	2,4-Dinitrotoluene	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	2,6-Dinitrotoluene	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	2.4-Dinitrophenol	ug/kg	0	9	0%	--	7.10E+00	1.39E+00	2.45E+04	--	X	4.16
8270C	2-Chloronaphthalene	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	2-Chlorophenol	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	2-Methyl-4,6-Dinitrophenol	ug/kg	0	9	0%	--	7.10E+00	1.39E+00	2.45E+04	--	X	4.16
8270C	2-Methylnaphthalene	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	o-Cresol	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	2-Nitroaniline	ug/kg	0	9	0%	--	7.10E+00	1.39E+00	2.45E+04	--	X	4.16
8270C	2-Nitrophenol	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	3,3'-Dichlorobenzene	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	3-Nitroaniline	ug/kg	0	9	0%	--	7.10E+00	1.39E+00	2.45E+04	--	X	4.16
8270C	4-bromophenyl-phenylether	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	4-Chloro-3-Methylphenol	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	4-Chloroaniline	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	4-Chlorophenyl-phenyl ether	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	4-Nitroaniline	ug/kg	0	9	0%	--	7.10E+00	1.39E+00	2.45E+04	--	X	4.16
8270C	4-Nitrophenol	ug/kg	0	9	0%	--	7.10E+00	1.39E+00	2.45E+04	--	X	4.16
8270C	Acenaphthene	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	Acenaphthylene	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	Anthracene	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	Benzo(g,h,I)Perylene	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	Benzo(k)Fluoranthene	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	Bis (2-chloroisopropyl)ether	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	bis(2-Chloroethoxy) Methane	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	bis(2-Chloroethyl) Ether	ug/kg	0	9	0%	--	5.16E+00	2.18E+00	2.21E+05	--	X	6.18
8270C	Butylbenzylphthalate	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	Dibenz(a,h)Anthracene	ug/kg	0	9	0%	--	5.01E+00	2.07E+00	9.39E+04	--	X	5.89
8270C	Dibenzofuran	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	Dimethylphthalate	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	di-N-Butylphthalate	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	di-N-Octylphthalate	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	Fluorene	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	Hexachlorobutadiene	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	Hexachlorocyclopentadiene	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	Hexachloroethane	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	Naphthalene	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	Nitrobenzene	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	N-Nitrosodi-N-Propylamine	ug/kg	0	9	0%	--	5.01E+00	2.07E+00	9.39E+04	--	X	5.89

Table 7-3: Summary Statistics for Analytical Data from Subsurface Soil (> 1 feet – 10 feet bgs) Samples

EPA Method	Analyte	Unit	No. of Detects	No. of Samples	Frequency of Detects (%)	Maximum Detect Concentration	Mean (Ln)	Standard Deviation (Ln)	95% UCL Concentrations	RME EPC Concentrations	Flag	H-Statistic
8270C	N-Nitroso-Diphenylamine	ug/kg	0	9	0%	--	6.18E+00	1.39E+00	9.95E+03	--	X	4.17
8270C	Pentachlorophenol	ug/kg	0	9	0%	--	5.88E+00	1.57E+00	1.57E+04	--	X	4.61
8290	Total 2,3,7,8-TCDD	pg/g	2	2	100%	4.24E-01	-1.95E+00	1.55E+00	--	4.24E-01		--
8290	Total 2,3,7,8-TCDD Bird	pg/g	2	2	100%	6.91E-02	-3.72E+00	1.49E+00	--	6.91E-02		--
8290	Total 2,3,7,8-TCDD Fish	pg/g	2	2	100%	6.96E-02	-3.72E+00	1.49E+00	--	6.96E-02		--
8290	Total 2,3,7,8-TCDD Mammal	pg/g	2	2	100%	4.24E-01	-1.95E+00	1.55E+00	--	4.24E-01		--
E314	Perchlorate	ug/kg	0	2	0%	--	5.52E+00	0.00E+00	--	--		--

NOTES:
RME = reasonable maximum exposure
EPC = exposure point concentrations
UCL = upper confidence limit
ln = natural logarithm
mg/kg = milligrams per kilogram
ug/kg = microgram per kilogram
pg/g = picogram per kilogram
% = percent
-- = not applicable
Cross mark in the Flag column indicates that the RME EPC for that analyte is the maximum concentration, since 95% UCL value is grater than the maximum concentrations.

Contaminant Source	Transport Mechanism	Exposure Route	Potential Human Receptors[1]				Rationale / Data Needs
			Current Escorted Visitors	Current & Future Residential, industrial and Construction[2] Workers	Current/Future Offsite Agricultural Workers	Future Onsite Recreational Users	
Surface Soil	Direct Contact	Dermal Absorption	Potentially Complete	Potentially Complete	Incomplete	Potentially Complete	Direct contact with surface soil is potentially complete for future industrial workers, construction workers, and ecological receptors (current and future).
		Incidental Ingestion	Potentially Complete	Potentially Complete	Incomplete	Potentially Complete	
	Air Transport	Inhalation of VOCs	Potentially Complete	Potentially Complete	Incomplete	Potentially Complete	Inhalation of contaminated dust is potentially complete for all onsite receptors, but not for offsite receptors.
		Inhalation of Particulates	Potentially Complete	Potentially Complete	Incomplete	Potentially Complete	
	Surface Water Runoff	Dermal Absorption	Incomplete	Potentially Complete	Potentially Complete	Potentially Complete	Surface water runoff and transport of dissolved contaminants is likely because of mixing with surface water from Agua Chinon Wash.
		Incidental Ingestion	Incomplete	Potentially Complete	Potentially Complete	Potentially Complete	
		Inhalation of VOCs	Incomplete	Potentially Complete	Potentially Complete	Potentially Complete	
		Bio-accumulation/ Consumption of Food	Incomplete	Incomplete	Incomplete	Incomplete	

Figure 7-1
Conceptual Site Model - Potential Exposure Scenarios
Human Health Risk Evaluation
Anomaly Area 3, MCAS El Toro

Contaminant Source	Transport Mechanism	Exposure Route	Potential Receptors[1]: Current Escorted Visitors	Current & Future Residential, industrial and Construction[2] Workers	Current/Future Offsite Agricultural Workers	Future Onsite Recreational Users	Rationale/Data Needs
Subsurface Soil	Unsaturated/ Saturated Zone Transport to Leachate to Groundwater	Dermal Absorption	Incomplete	Potentially Complete	Potentially Complete	Potentially Complete	Exposure to groundwater is potentially complete if groundwater is pumped for agricultural use or becomes a future source of drinking water.
		Incidental Ingestion	Incomplete	Potentially Complete	Potentially Complete	Potentially Complete	
		Inhalation of VOCs	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	
		Bio-accumulation/ Consumption of Food	Incomplete	Incomplete	Incomplete	Incomplete	
	Direct Contact	Dermal Absorption	Incomplete	Potentially Complete	Incomplete	Potentially Complete	Direct contact with subsurface soil is potentially complete for construction workers, recreational users, and industrial workers if future construction work brings subsurface soil to the surface. Exposure of ecological receptors is assumed to be insignificant in areas of industrial development due to disruption of habitat.
		Incidental Ingestion	Incomplete	Potentially Complete	Incomplete	Potentially Complete	

Note: [1] Ecological receptors and offsite agricultural well users are present for current and potential future use conditions; all other receptors are for potential future use conditions.

Figure 7-1 (continued)
Conceptual Site Model - Potential Exposure Scenarios
Human Health Risk Evaluation
Anomaly Area 3, MCAS El Toro

The primary purpose of the CSM in this risk evaluation is to structure the PRE in order to determine if exposure pathways are incomplete (and require no further evaluation) or complete. Only potentially complete exposure pathways are evaluated quantitatively in the risk assessment, consistent with EPA guidance (EPA 1989a).

A complete exposure pathway must have all of the following elements:

- Sources and type of chemicals present
- Chemical release and transport mechanisms (e.g., spillage and advection, vaporization)
- Known and potential routes of exposure (e.g., ingestion, dermal contact, inhalation)
- Known or potential human and environmental receptors (e.g., residents, workers)

The absence of any one of these elements results in an incomplete exposure pathway. Thus, for an incomplete pathway with no potential human exposure, the potential for adverse health effects would be deemed negligible and does not warrant further evaluation. Figure 7-1 is the CSM for current and anticipated future receptors potentially exposed to COPCs in surface soil, subsurface soil, and groundwater associated with AA 3.

The exposure pathways for each scenario and each receptor shown in the CSM are described in Section 7.4.3.

7.4.3 Exposure Pathways

Exposure pathways are specifically associated with the environmental medium that is being evaluated. In a generic context, soil, water, and air pathways may facilitate exposure; each of these might result in intake by applicable exposure routes, such as ingestion, dermal absorption, or inhalation. In most settings, exposure pathways may be incomplete or complete, as discussed in Section 7.4.2. The rationale for making this determination is presented below.

7.4.3.1 Incomplete Exposure Pathways

Of those exposure pathways that are presented in Figure 7-1, several have been deemed to be incomplete, insignificant, or not applicable to the PRE. Thus, these pathways do not warrant quantitative assessment. The rationale for excluding a pathway from further evaluation follows.

7.4.3.1.1 Air Pathway

An air pathway can be divided into vapor and particulate exposure routes. The air/vapor pathway is potentially incomplete for offsite receptors due to the potential for emitted VOCs to be dispersed, thus reducing concentrations to negligible levels offsite (Figure 7-1). Similarly, the air/particulate pathway is incomplete for offsite receptors due to wind induced particle dispersion resulting in low or negligible concentrations of COPC at receptor breathing zones.

7.4.3.1.2 Soil Pathways

The soil pathways are characterized by dermal absorption and incidental ingestion of chemicals associated with surface soil particles. Physical touching, handling, or otherwise coming into direct contact with the soil primarily facilitates these exposure routes. The soil pathway is incomplete for offsite receptors by virtue of their location relative to the onsite soil (Figure 7-1).

7.4.3.2 POTENTIALLY COMPLETE EXPOSURE PATHWAYS

Potential exposures to COPCs in surface and subsurface soil-derived pathways require quantitative assessment. A discussion of those pathways that require further evaluation follows.

7.4.3.2.1 Air Pathway

The air/particulate pathway is potentially complete for all onsite receptors due to the potential for chemicals associated with soil to be suspended to breathing zone air, thus facilitating inhalation exposures (Figure 7-1).

7.4.3.2.2 Soil Pathway

The soil pathway includes two routes of exposure: dermal and ingestion. Dermal absorption and particle inhalation of COPCs associated with soil particles all have the potential to be complete for onsite receptors. Thus, for the purposes of pathway evaluation, direct contact pathways for surface soil are considered potentially complete, requiring quantitative evaluation.

7.4.3.2.3 Surface Water Pathway

Figure 7-1 indicates that COPCs could conceivably be transported with surface water, resulting in potential incidental contact. While believed to be a relatively minor exposure mechanism, these pathways are considered potentially complete for all current and future receptors.

7.4.3.2.4 Groundwater Pathway

Contact with COPCs in groundwater is considered minor given its current use status in and around the site. However, this pathway could become complete if the groundwater is used for agricultural purposes or put into use by the state as a drinking water source.

7.4.4 Estimation of Exposure Point Concentrations

In this PRE, the calculation of EPCs was performed per EPA guidance (EPA 1992b), an approach endorsed by risk assessment staff of EPA Region IX. In brief, the EPC upon which further action is predicated is selected in order to characterize the RME for a receptor group where the RME is defined as "...the highest exposure that is reasonably expected to occur at a site" (EPA 1989a).

Based on the relative magnitudes of the "maximum detected" (MAX) concentration and the 95 percent UCL (i.e., the 95 percent UCL of the arithmetic mean assuming that data are log-normally distributed per EPA [1992b] and EPA Region IX) the RME EPC can be defined as the lower value of the MAX value and the 95 percent UCL value.

The following equation developed by Land (1975) and cited by EPA (1992b) was used for this calculation.

$$95\%UCL = e^{\left[\bar{x}+0.5s^2+\frac{sH}{\sqrt{n-1}}\right]}$$

Where, e = Base of natural log

$\bar{x}$ = Arithmetic mean of the natural logarithms of the analyte concentrations s = Standard deviation of the natural logarithms of the analyte concentrations

H = H-statistic (Gilbert 1987)

n = Number of COPC data points.

When the maximum value exceeded the 95 percent UCL, the 95 percent UCL was chosen as the RME EPC. Alternatively, when the maximum value was less than the 95 percent UCL, the maximum value was chosen as the RME EPC. Regardless of the RME EPC selected, maximum EPCs and RME EPCs were both used in the PRE to evaluate risk.

7.5 Screening Preliminary Risk Evaluation

The human health SPRE included the following steps:

Development of a CSM. Analysis of the CSM identified potentially complete exposure pathways for both current and future land uses (Section 7.4.2).

Identification of Relevant Data Sets. For this risk assessment, surface and subsurface soil data were evaluated quantitatively. Even though the groundwater pathway has been determined to be complete, groundwater data were not evaluated in the PRE, since the COPCs identified had concentrations less than their MCL values, with the exception of two detections of chromium and one detection each of nickel and selenium. Other organic COPCs include m/p-creosol, diethylphthalate, and phenol. There are no established MCL values associated with these inorganics. However, the nature and extent of any groundwater contamination is presented in the Section 6.5 of the ESI report.

Analytical data for TPH-gasoline and TPH-diesel were not included in the quantitative evaluation, but were compared to relevant regulatory levels in the Section 6 of the ESI report.

Identification of COPCs. Any chemical detected in the soil or other media at the site was considered a COPC for the site.

Calculation of EPCs. Both maximum EPCs (the maximum detected concentration) and RME EPCs were calculated for each stratum. If the 95 percent UCL concentration exceeded the maximum detected concentration for a specific chemical data set, the maximum detected concentration was used as the RME EPC; otherwise, the 95 percent UCL was used as the RME EPC. COPC concentrations noted as "non-detect" were represented by one-half the reporting limit.

Comparison of COPC EPCs to Screening Criteria. The EPCs were compared to EPA Region IX (EPA 2002b) residential PRGs to provide options for land use considerations. If risks and noncancer hazards for residential exposures exceeded the points of departure (i.e., 10^{-6} for carcinogenic effects and hazard index [HI] of 1.0 for noncarcinogenic effects), the EPCs were then compared to EPA Region IX industrial PRGs. A discussion of the relevancy of the PRGs used in the SPRE follows.

EPA Region IX soil PRGs are concentrations of COPCs in soil that are based on standardized equations and exposure factors for residential and industrial land use. Corresponding to the points of departure defined in the NCP (EPA 1990) (i.e., a cancer risk of 10^{-6} or a noncancer hazard quotient [HQ] of 1), soil PRGs represent COPC concentrations at or below which no substantive adverse health effects are likely to occur from the exposures assumed in the PRE.

EPA Region IX PRGs do not consider all possible soil exposure pathways. For instance, some of the exposure scenarios for which the PRG use is not intended include exposure to COPCs in indoor air from soil gas; water used for swimming, wading, or bathing; food such as contaminated fish, meat, dairy products, fruit, or vegetables; and groundwater contaminated from leaching processes. Further, and as noted by EPA Region IX, PRGs are not intended as stand-alone decision-making tools or as substitutes for EPA guidance when preparing risk assessments. However, they do suffice to evaluate the potential for adverse health effects for a relatively wide range of exposure conditions and land uses (i.e., residential and industrial) commonly encountered by the DoN. In such applications, risk can be adequately characterized if exposure assumptions inherent in the PRGs are similar to those made in the exposure assessment of the PRE.

The EPA Region IX PRGs are used to identify COPCs. For instance, EPCs for chemicals in soil exceeding residential PRGs are identified as COPCs in the site-specific PRE. Such a comparison also provides insight into the potential for unrestricted land use for the site, and in cases where the site is industrial, PRGs for industrial land use are potential target cleanup goals protective of industrial workers. The SPRE first entailed a comparison of site EPCs to residential PRGs for relevant exposure pathways. This comparison was performed:

- If the complete or potentially complete exposure pathways of concern at a site were identical to those used in the development of PRGs, and
- If the pathway-specific exposure parameters were similar to the EPA Region IX default assumptions used to develop the PRGs.

If this comparison indicated risk at or below the target cancer risk of 10^{-6} and the noncancer HI of 1.0 (i.e., points of departure), the PRE was considered complete and further evaluation was deemed unwarranted. However, if the comparisons indicated risk above the cancer and noncancer points of departure, all EPCs were compared to industrial PRGs to characterize risk to receptors under that land use scenario. If the potential for adverse health effects was indicated by this comparison, or if exposure pathways and parameters were identified that differed from those used to develop the PRGs, a SSPRE was completed. In this case, only those chemicals that exceeded the PRG screening process were carried forward.

As noted earlier, the exposure pathways and default exposure factors are assumed to be the same as those used to develop the PRGs. However, because no EPA Region IX PRGs are available for exposures to construction/utility workers, recreational users, and agricultural workers, potential exposures to COPC under a distinct exposure scenario were evaluated for these receptors in the SSPRE.

7.5.1 Selection of Screening Criteria

As noted above, the general approach for the human health SPRE is to conduct a risk screening using EPA Region IX PRGs. Chemical-specific toxicity values are integrated with the exposure parameters to derive the PRGs. A summary of the approach used to the obtain toxicity values follows.

7.5.1.1 Toxicity Values

Because PRGs are based on the toxicity of chemicals that may be ingested, inhaled, or dermally absorbed, it is helpful to understand the derivation of toxicity values used in a toxicity assessment. The purpose of the toxicity assessment is to weigh the available evidence regarding the potential for chemicals to cause adverse health effects and to provide a quantitative estimate of the relationship between the magnitude of exposure and the likelihood or severity of adverse health effects (i.e., dose-response assessment; EPA 1989a). Toxicity values are used to provide a quantitative estimate of the relationship between the magnitude of exposure and the potential for adverse health effects.

7.5.1.1.1 Toxicity Values for Noncarcinogens

Toxicity values are presented as reference doses (RfDs) for noncarcinogens. The EPA Region IX PRG tables provided all the RfDs used in the current PRE (EPA 2002b). EPA Region IX obtained all of the noncarcinogenic toxicity values used in this PRE from the Integrated Risk Information System database (EPA 2003a).

Oral RfDs (expressed in units of mg/kg-day) have been developed to evaluate the potential for adverse noncancer health effects from ingestion of chemicals. Chronic RfDs are specifically developed to be protective for long-term exposure to a chemical and are generally used to evaluate the potential noncancer effects associated with exposure periods between 7 years and a lifetime (EPA 1989a). The RfD is derived from a no-observed-adverse-effect-level (NOAEL) or a lowest-observed-adverse-effect-level (LOAEL). For the risk assessment, a NOAEL is the key datum obtained from a study of a dose-response relationship. It is the highest level tested at which no adverse effects were demonstrated. In some studies, only a LOAEL rather than a NOAEL is available. However, the use of a LOAEL requires additional uncertainty factors (UFs) and modifying factors (MFs) to ensure that a health-protective toxicity value is used.

UFs are typically 10 fold factors used for estimating RfDs from laboratory data (EPA 2001) to account for the (1) variation in sensitivity among the members of the human population (i.e., inter-human or intra-species variability); (2) uncertainty in extrapolating animal data to humans (i.e., interspecies variability); (3) uncertainty in extrapolating from data obtained in a study with less-than-lifetime exposure to lifetime exposure (i.e., extrapolating from sub-chronic to chronic exposure); (4) uncertainty in extrapolating from a LOAEL rather than from a NOAEL; and (5) uncertainty associated with extrapolation from animal data when the database is incomplete.

MFs are included to reflect the scientific uncertainties not explicitly addressed using UFs, and range from 1 to 10. The default value for a MF is 1.

Methods used to derive inhalation RfDs are conceptually similar to those used to derive oral RfDs. However, the actual analysis of inhalation exposures is more complex than that for oral exposures because of the dynamics and differential structures of the respiratory system and the ability to account for the inhaled dose in the experiment design of laboratory studies. The reference values from inhalation studies are generally reported as a reference concentration (RfC) in air (milligrams per cubic meter [mg/m^3]). However, these values are converted to RfDs for use in risk assessments. As noted in its documentation, EPA Region IX has converted inhalation RfCs to RfDs using a human body weight of 70 kilograms (kg) and inhalation rate of 20 cubic meters per day (m^3/day).

All screening tables presented in this PRE (Tables 7-4, 7-5, 7-6, and 7-7) present the PRGs predicated on noncarcinogenic toxicity values recommended by EPA Region IX.

7.5.1.2 TOXICITY VALUES FOR CARCINOGENS

The predominant theory behind cancer development as it relates to risk assessment is that a small number of molecular events can evoke changes in a single cell, which can lead to uncontrolled cellular proliferation and, eventually, to cancer. In this model (i.e., the linear low dose model), therefore, it is assumed that there is no level of exposure to a chemical that does not pose "a finite probability, however small, of generating a carcinogenic response" (EPA 1989a). Recent insight into the cancer processes does, however, suggest that theoretically, a threshold mechanism may be operative, especially if the cancer is a "...secondary effect of toxicity or of an induced physiological change that is itself a threshold" (EPA 1999a). Data are not yet sufficient to apply the "threshold" concept in the development of risk assessments for carcinogens that are intended to be protective of the potentially exposed receptor group. Thus, the linear low-dose model is still considered applicable.

The evaluation of the chemical carcinogenicity is a complex process that can be summarized by two primary steps. Initially, the toxicity database for a substance is evaluated for its potential utility in assessing carcinogenic potential. In this step, a weight-of-evidence (WOE) classification is assigned to the chemical. The WOE classification scheme is designed to present the likelihood that a chemical will cause cancer in humans based on the strength of supporting human and/or animal data. The WOE classifications defined by EPA (1989a) are

Group A:	Known human carcinogen
Group B:	Probable human carcinogen
Group B1:	Limited evidence of carcinogenicity in humans
Group B2:	Sufficient evidence in animals, but inadequate evidence in humans
Group C:	Possible human carcinogen (limited evidence of carcinogenicity in animals in the absence of human data)
Group D:	Human carcinogenicity not classifiable because of lack of data
Group E:	Evidence of non-carcinogenicity in humans (no evidence in at least two adequate animal tests in different species or in both epidemiological and animal studies)

Oral cancer slope factors (CSFo), are expressed as the proportion of a population affected per mg/kg-day dose (EPA 2002b) and are typically reported in units of $(mg/kg\text{-}day)^{-1}$. CSFo are derived for chemicals with WOE classifications of A, B1, or B2, and occasionally C. Inhalation cancer toxicity data are presented as a unit risk (expressed as $[mg/m^3]^{-1}$ or micrograms per cubic meter $[\mu g/m^3]^{-1}$) and can be interpreted as "...the increase in the lifetime risk of an individual who is exposed for a lifetime to either 1 mg/m^3 or $\mu g/m^3$ of the cancer agent" (EPA 2002b). EPA Region IX converted unit risks to CSFo by multiplying by the inhalation rate of 20 m^3/day and dividing by a body weight of 70 kg. Tables 7-4, 7-5, 7-6, and 7-7 present the PRGs that are predicated on carcinogenic toxicity values recommended by EPA Region IX.

7.5.1.3 Availability of Toxicity Values

Some chemicals may exhibit both carcinogenic and noncarcinogenic health effects. Toxicity values are generally available for the oral route of exposure. Inhalation toxicity values have also been developed for some constituents. However, route-to-route extrapolations are frequently used when there are no toxicity values available for a given route of exposure. Oral CSFo and RfDo were used for both oral and inhalation routes of exposures for organic chemicals lacking inhalation values (EPA 2002b).

Chemical disposition in the body may determine the dose of toxicant that reaches the target organ, confounding the interpretation of toxicity values. For instance, dermal exposures rarely result in the entire applied dose entering systemic circulation. However, because this phenomenon is poorly quantified, toxicity values for evaluating risk from dermal exposure may employ route-to-route (oral to dermal) extrapolations that do not consider the fraction absorbed. Similarly, for the oral route, the orally administered dose is often not entirely absorbed from the gastrointestinal (GI) tract into systemic circulation. Because of incomplete absorption from the GI tract, correcting the administered dose by the fraction absorbed might be preferred to better determine a toxicity value that reflects the actual dose to the target organ.

Table 7-4: Screening PRE - Comparison of Surface Soil (0 - 1 feet bgs) EPCs at AA 3 to Residential PRGs

												Maximum EPC Comparisons						RME EPC Comparisons					
												Carcinogenic			Noncarcinogenic			Carcinogenic			Noncarcinogenic		
Chemical	Number of Detects	Sample Size[a]	Frequency of Detection	Max EPC (mg/kg)[b]	95% UCL of Arithmetic Mean (mg/kg)	RME EPC (mg/kg)[c]	Background Concentration (mg/kg)	Carcinogenic PRG[d] (mg/kg)	Noncarcinogenic PRG[d] (mg/kg)	SSL DAF 1 (mg/kg)[e]	>SSL	>PRG (ca)	Excess Cancer Risk[f]	% Contribution to Risk	>PRG (nc)	HQ[g]	% Contribution to HI	>PRG (ca)	Excess Cancer Risk[h]	% Contribution to Risk	>PRG (nc)	HQ[i]	% Contribution to HI
Metals (6010B & 7471A)																							
Aluminum	33	33	100%	1.58E+04	1.02E+04	1.02E+04	14,800	–	7.61E+04	–	–	–	–	–	No	2.08E-01	13%	–	–	–	No	1.34E-01	12%
Antimony	1	33	3%	2.10E+00	5.71E+02	2.10E+00	3.06	–	3.13E+01	3.00E-01	Yes	–	–	–	No	6.71E-02	4%	–	–	–	No	6.71E-02	6%
Arsenic	33	33	100%	4.60E+00	3.19E+00	3.19E+00	6.86	3.90E-01	2.16E+01	1.00E+00	Yes	Yes	1.18E-05	28%	No	2.13E-01	13%	Yes	8.19E-06	65%	No	1.47E-01	13%
Barium	33	33	100%	1.87E+02	1.08E+02	1.08E+02	173	–	5.37E+03	8.20E+01	Yes	–	–	–	No	3.48E-02	2%	–	–	–	No	2.01E-02	2%
Berylium	10	33	30%	3.10E-01	1.93E-01	1.93E-01	0.669	–	1.54E+02	3.00E+00	No	–	–	–	No	2.01E-03	0%	–	–	–	No	1.25E-03	0%
Cadmium	33	33	100%	1.00E+00	7.28E-01	7.28E-01	2.35	1.68E+00	3.70E+01	4.00E-01	Yes	No	5.97E-07	1%	No	2.70E-02	2%	No	4.35E-07	3%	No	1.97E-02	2%
Calcium	33	33	100%	2.52E+04	6.05E+03	6.05E+03	46,000	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chromium	33	33	100%	1.58E+01	1.11E+01	1.11E+01	26.9	2.11E+02	–	2.00E+00	Yes	No	7.50E-08	0%	–	–	–	No	5.27E-08	0%	–	–	–
Cobalt	33	33	100%	7.60E+00	5.12E+00	5.12E+00	6.98	9.03E+02	–	–	–	No	8.42E-09	0%	–	–	–	No	5.67E-09	0%	–	–	–
Copper	33	33	100%	1.08E+01	6.95E+00	6.95E+00	10.5	–	3.13E+03	–	–	–	–	–	No	3.45E-03	0%	–	–	–	No	2.22E-03	0%
Iron	33	33	100%	1.94E+04	1.26E+04	1.26E+04	18,400	–	2.35E+04	–	–	–	–	–	No	8.27E-01	50%	–	–	–	No	5.37E-01	49%
Lead	33	33	100%	2.07E+01	8.88E+00	8.88E+00	15.1	–	1.50E+02	–	–	–	–	–	No	k	–	–	–	–	No	k	–
Magnesium	33	33	100%	6.90E+03	4.46E+03	4.46E+03	8,370	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Manganese	33	33	100%	2.89E+02	1.98E+02	1.98E+02	291	–	1.76E+03	–	–	–	–	–	No	1.64E-01	10%	–	–	–	No	1.12E-01	10%
Mercury	33	33	100%	6.90E-02	3.08E-02	3.08E-02	0.22	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nickel	33	33	100%	1.21E+01	7.79E+00	7.79E+00	15.3	–	1.56E+03	7.00E+00	Yes	–	–	–	No	7.74E-03	0%	–	–	–	No	4.98E-03	0%
Potassium	33	33	100%	3.97E+03	2.70E+03	2.70E+03	4,890	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Selenium	20	33	61%	1.10E+00	5.42E-01	5.42E-01	0.32	–	3.91E+02	3.00E-01	Yes	–	–	–	No	2.81E-03	0%	–	–	–	No	1.39E-03	0%
Silver	1	33	3%	2.00E+00	6.32E-01	6.32E-01	0.539	–	3.91E+02	2.00E+00	No	–	–	–	No	5.11E-03	0%	–	–	–	No	1.62E-03	0%
Vanadium	33	33	100%	4.41E+01	2.84E+01	2.84E+01	71.8	–	5.47E+02	3.00E+02	No	–	–	–	No	8.05E-02	5%	–	–	–	No	5.19E-02	5%
Zinc	33	33	100%	5.71E+01	3.81E+01	3.81E+01	77.9	–	2.35E+04	6.20E+02	No	–	–	–	No	2.43E-03	0%	–	–	–	No	1.62E-03	0%
Extractable Hydrocarbons (8015B)																							
PHC as Diesel Fuel	14	33	42%	1.50E+01	6.28E+00	6.28E+00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PHC as Motor Oil	20	33	61%	1.60E+02	2.48E+01	2.48E+01	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Purgeable Hydrocarbons (8015B)																							
PHC as Gasoline	26	33	79%	2.77E+00	9.07E-02	9.07E-02	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Semivolatile Organics (8270C)																							
bis(2-Ethylhexyl) Phthalate	3	33	9%	7.00E-02	8.79E-02	7.00E-02	–	3.47E+01	–	–	–	No	2.01E-09	0%	–	–	–	No	2.01E-09	0%	–	–	–
Diethylphthalate	1	33	3%	2.25E-01	2.25E-01	2.25E-01	–	–	4.89E+04		–	–	–	–	No	4.60E-06	0%	–	–	–	No	4.60E-06	0%
Phenol	12	33	36%	9.36E-01	3.90E-01	3.90E-01	–	–	3.67E+04	5.00E+00	No	–	–	–	No	2.55E-05	0%	–	–	–	No	1.06E-05	0%
Semivolatile Organics (8270C-SIM)																							
Anthracene	1	33	3%	4.40E-02	1.56E-02	1.56E-02	–	–	2.19E+04	5.90E+02	No	–	–	–	No	2.01E-06	0%	–	–	–	No	7.12E-07	0%
Benzo(a)Anthracene	7	33	21%	7.30E-01	2.60E-02	2.60E-02	–	6.21E-01	–	8.00E-02	Yes	Yes	1.17E-06	3%	–	–	–	No	4.18E-08	0%	–	–	–
Benzo(a)pyrene	4	33	12%	1.03E+00	2.77E-02	2.77E-02	–	6.21E-02	–	4.00E-01	Yes	Yes	1.66E-05	40%	–	–	–	No	4.46E-07	4%	–	–	–
Benzo(b)Fluoranthene	5	33	15%	1.79E+00	3.36E-02	3.36E-02	–	6.21E-01	–	2.00E-01	Yes	Yes	2.88E-06	7%	–	–	–	No	5.41E-08	0%	–	–	–
Benzo(g,h,I)Perylene	4	33	12%	4.40E-01	2.28E-02	2.28E-02	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Benzo(k)Fluoranthene	4	33	12%	5.10E-01	2.34E-02	2.34E-02	–	3.78E-01	–	2.00E+00	No	Yes	1.35E-06	3%	–	–	–	No	6.19E-08	0%	–	–	–
Chrysene	4	33	12%	8.70E-01	2.70E-02	2.70E-02	–	3.78E+00	–	8.00E+00	No	No	2.30E-07	1%	–	–	–	No	7.14E-09	0%	–	–	–
Dibenz(a,h)Anthracene	1	33	3%	9.70E-02	1.74E-02	1.74E-02	–	6.21E-02	–	8.00E-02	Yes	Yes	1.56E-06	4%	–	–	–	No	2.80E-07	2%	–	–	–
Fluoranthene	5	33	15%	1.00E+00	2.75E-02	2.75E-02	–	–	2.29E+03	2.10E+02	No	–	–		No	4.36E-04	0%	–	–	–	No	1.20E-05	0%
indeno(1,2,3-c,d)Pyrene	2	33	6%	4.60E-01	2.32E-02	2.32E-02	–	6.21E-01	–	7.00E-01	No	No	7.40E-07	2%	–	–	–	No	3.73E-08	0%	–	–	–
Phenanthrene	2	33	6%	2.90E-01	2.09E-02	2.09E-02	–	–	–		–	–	–	–	–	–	–	–	–	–	–	–	–
Pyrene	5	33	15%	9.60E-01	2.75E-02	2.75E-02	–	–	2.32E+03	2.10E+02	No	–	–	–	No	4.15E-04	0%	–	–	–	No	1.19E-05	0%
Dioxins and Furans (8290)																							
Total 2,3,7,8-TCDD	9	9	100%	1.84E-05	1.14E-05	1.14E-05	–	3.90E-06	–	–	–	Yes	4.72E-06	11%	–	–	–	Yes	2.92E-06	23%	–	–	–
Total 2,3,7,8-TCDD Bird	9	9	100%	3.53E-05	2.26E-05	2.26E-05	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Total 2,3,7,8-TCDD Fish	9	9	100%	1.82E-05	1.08E-05	1.08E-05	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Total 2,3,7,8-TCDD Mammal	9	9	100%	1.84E-05	1.14E-05	1.14E-05	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
												Cumulative Excess Cancer Risk/Hazard Index Including Background:	4.17E-05			1.64E+00			1.25E-05			1.10E+00	

NOTES:

- = no data or not applicable
% = percent
ca = carcinogenic
HI = hazard index
mg/kg = milligrams per kilogram
nc = noncarcinogenic
PRG = preliminary remediation goals
SSL = soil screening levels
EPC = exposure point concentration
HI = hazard index
HQ = hazard quotient
RME = reasonable maximum exposure

[a] Sample size does not include field or laboratory quality control samples; field duplicate result is averaged with original sample result.
[b] Maximum EPC is the maximum detected concentration of an analyte.
[c] RME EPC is the minimum of either the 95% UCL of the arithmetic mean or the maximum EPC.
The 95% UCL is calculated as $e^{(mean + 0.5s^2 + sH/(n-1)^{0.5})}$, where mean = mean of the natural log transformed data; s = standard deviation of the natural log transformed data; H = H-statistic from EPA 1992; and n = number of samples.
[d] PRGs are based on cancer risk or noncarcinogenic health effects, unless qualified with a "sat" (soil saturation concentration) or "max" (ceiling limit concentration). Excess cancer risks or HQs are not calculated for chemicals of potential concern with non-risk-based PRGs (sat or max), which are discussed qualitatively in the Uncertainty Section of the text.
[e] Soil screening levels (SSLs) for the protection of groundwater from EPA Region IX PRG table (EPA Region IX 2002). A dilution attenuation factor (DAF) of 1 assumes that no dilution occurs and the concentration in the receptor well equals the soil leachate concentration.

[f] Excess cancer risk = 1E-06 x (Maximum EPC / Carcinogenic PRG)
[g] HQ = Maximum EPC / Noncarcinogenic PRG
[h] Excess cancer risk = 1E-06 x (RME EPC / Carcinogenic PRG)
[i] HQ = RME EPC / Noncarcinogic PRG
[k] An HQ for lead could not be determined because the PRGs for lead were developed using blood-lead levels and a reference dose is not available.
Shading identifies chemicals with concentrations exceeding EPA Region IX PRGs (EPA Region IX 2002).

Table 7-5: Screening PRE - Comparison of Subsurface Soil (>1 feet to 10 feet bgs) EPCs at AA 3 to Residential PRGs

Chemical	Number of Detects	Sample Size [a]	Frequency of Detection	Max EPC (mg/kg) [b]	95% UCL of Arithmetic Mean (mg/kg)	RME EPC (mg/kg) [c]	Background Concentration (mg/kg)	Carcinogenic PRG [d] (mg/kg)	Noncarcinogenic PRG [d] (mg/kg)	SSL DAF 1 (mg/kg) [e]	>SSL	Maximum EPC Comparisons: Carcinogenic >PRG (ca)	Maximum EPC Comparisons: Carcinogenic Excess Cancer Risk [f]	Maximum EPC Comparisons: Carcinogenic % Contribution to Risk	Maximum EPC Comparisons: Noncarcinogenic >PRG (nc)	Maximum EPC Comparisons: Noncarcinogenic HQ [g]	Maximum EPC Comparisons: Noncarcinogenic % Contribution to HI	RME EPC Comparisons: Carcinogenic >PRG (ca)	RME EPC Comparisons: Carcinogenic Excess Cancer Risk [h]	RME EPC Comparisons: Carcinogenic % Contribution to Risk	RME EPC Comparisons: Noncarcinogenic >PRG (nc)	RME EPC Comparisons: Noncarcinogenic HQ [i]	RME EPC Comparisons: Noncarcinogenic % Contribution to HI
Metals (6010B & 7471A)																							
Arsenic	9	9	100%	4.63E+00	3.93E+00	3.93E+00	6.86	3.90E-01	2.16E+01	1.00E+00	Yes	Yes	1.19E-05	67%	No	2.14E-01	48%	Yes	1.01E-05	64%	No	1.82E-01	46%
Barium	9	9	100%	1.12E+02	1.00E+02	1.00E+02	173	--	5.37E+03	8.20E+01	Yes	--	--	--	No	2.08E-02	5%	--	--	--	No	1.86E-02	5%
Chromium	9	9	100%	1.64E+01	1.46E+01	1.46E+01	26.9	2.11E+02	--	2.00E+00	Yes	No	7.78E-08	0%	--	--	--	No	6.93E-08	0%	--	--	--
Cobalt	9	9	100%	5.33E+00	4.62E+00	4.62E+00	6.98	9.03E+02	--	--	--	No	5.90E-09	0%	--	--	--	No	5.12E-09	0%	--	--	--
Copper	9	9	100%	1.27E+01	1.04E+01	1.04E+01	10.5	--	3.13E+03	--	--	--	--	--	No	4.06E-03	1%	--	--	--	No	3.32E-03	1%
Lead	9	9	100%	1.33E+01	1.29E+01	1.29E+01	15.1	--	1.50E+02	--	--	--	--	--	No	k	--	--	--	--	No	k	--
Manganese	9	9	100%	2.32E+02	2.14E+02	2.14E+02	291	--	1.76E+03	--	--	--	--	--	No	1.32E-01	29%	--	--	--	No	1.21E-01	31%
Nickel	8	9	89%	1.37E+01	1.69E+01	1.37E+01	15.3	--	1.56E+03	7.00E+00	Yes	--	--	--	No	8.76E-03	2%	--	--	--	No	8.76E-03	2%
Vanadium	9	9	100%	3.56E+01	3.06E+01	3.06E+01	71.8	--	5.47E+02	3.00E+02	No	--	--	--	No	6.50E-02	15%	--	--	--	No	5.59E-02	14%
Zinc	9	9	100%	4.83E+01	4.31E+01	4.31E+01	77.9	--	2.35E+04	6.20E+02	No	--	--	--	No	2.06E-03	0%	--	--	--	No	1.84E-03	0%
Extractable Hydrocarbons (8015B)																							
PHC as Diesel Fuel	6	9	67%	5.60E+03	1.20E+05	5.60E+03	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Volatile Organics (8260B)																							
Acetone	5	9	56%	1.00E-01	8.19E-02	8.19E-02	--	--	1.57E+03	8.00E-01	No	--	--	--	No	6.37E-05	0%	--	--	--	No	5.22E-05	0%
Benzene	1	9	11%	2.45E-03	--	2.45E-03	--	6.01E-01	--	2.00E-03	Yes	No	4.08E-09	0%	--	--	--	No	4.08E-09	0%	--	--	--
Methylene Chloride	1	9	11%	9.20E-03	6.81E-03	6.81E-03	--	9.11E+00	--	1.00E-03	Yes	No	1.01E-09	0%	--	--	--	No	7.48E-10	0%	--	--	--
Semivolitile Organics (8270C)																							
Benzo(a)Anthracene	1	9	11%	2.70E-01	2.43E-01	2.43E-01	--	6.21E-01	--	8.00E-02	Yes	No	4.34E-07	2%	--	--	--	No	3.91E-07	2%	--	--	--
Benzo(a)pyrene	1	9	11%	2.30E-01	1.18E+00	2.30E-01	--	6.21E-02	--	4.00E-01	No	Yes	3.70E-06	21%	--	--	--	Yes	3.70E-06	24%	--	--	--
Benzo(b)Fluoranthene	1	9	11%	4.40E-01	3.96E-01	3.96E-01	--	6.21E-01	--	2.00E-01	Yes	No	7.08E-07	4%	--	--	--	No	6.37E-07	4%	--	--	--
Chrysene	1	9	11%	2.50E-01	2.28E-01	2.28E-01	--	3.78E+00	--	8.00E+00	No	No	6.61E-08	0%	--	--	--	No	6.03E-08	0%	--	--	--
Diethylphthalate	2	9	22%	2.60E-01	2.93E-01	2.60E-01	--	--	4.89E+04	--	--	--	--	--	No	5.32E-06	0%	--	--	--	No	5.32E-06	0%
Fluoranthene	1	9	11%	6.00E-01	6.06E-01	6.00E-01	--	--	2.29E+03	2.10E+02	No	--	--	--	No	2.62E-04	0%	--	--	--	No	2.62E-04	0%
Hexachlorbenzene	1	9	11%	1.50E-01	4.06E+00	1.50E-01	--	3.04E-01	--	1.00E-01	Yes	No	4.93E-07	3%	--	--	--	No	4.93E-07	3%	--	--	--
indeno(1,2,3-c,d)Pyrene	1	9	11%	8.10E-02	3.39E+01	8.10E-02	--	6.21E-01	--	7.00E-01	No	No	1.30E-07	1%	--	--	--	No	1.30E-07	1%	--	--	--
Phenanthrene	1	9	11%	1.40E-01	--	1.40E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pyrene	1	9	11%	4.60E-01	4.19E-01	4.19E-01	--	--	2.32E+03	2.10E+02	No	--	--	--	No	1.99E-04	0%	--	--	--	No	1.81E-04	0%
Dioxins and Furans (8290)																							
Total 2,3,7,8-TCDD	2	2	100%	4.24E-07	4.24E-07	4.24E-07	--	3.90E-06	--	--	--	No	1.09E-07	1%	--	--	--	No	1.09E-07	1%	--	--	--
Total 2,3,7,8-TCDD Bird	2	2	100%	8.46E-03	8.46E-03	8.46E-03	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total 2,3,7,8-TCDD Fish	2	2	100%	8.43E-03	8.43E-03	8.43E-03	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total 2,3,7,8-TCDD Mammal	2	2	100%	4.76E-02	4.76E-02	4.76E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cumulative Excess Cancer Risk/Hazard Index Including Background:													1.76E-05			4.47E-01			1.57E-05			3.92E-01	

NOTES:

-- = no data or not applicable
% = percent
ca = carcinogenic
HI = hazard index
mg/kg = milligrams per kilogram
nc = noncarcinogenic
PRG = preliminary remediation goals
SSL = soil screening levels
EPC = exposure point concentration
HI = hazard index
HQ = hazard quotient
RME = reasonable maximum exposure

[a] Sample size does not include field or laboratory quality control samples; field duplicate result is averaged with original sample result.
[b] Maximum EPC is the maximum detected concentration of an analyte.
[c] RME EPC is the minimum of either the 95% UCL of the arithmetic mean or the maximum EPC.
The 95% UCL is calculated as $e^{(mean + 0.5s^2 + sH/(n-1)^{0.5})}$, where mean = mean of the natural log transformed data; s = standard deviation of the natural log transformed data; H = H-statistic from EPA 1992; and n = number of samples.
[d] PRGs are based on cancer risk or noncarcinogenic health effects, unless qualified with a "sat" (soil saturation concentration) or "max" (ceiling limit concentration). Excess cancer risks or HQs are not calculated for chemicals of potential concern with non-risk-based PRGs (sat or max), which are discussed qualitatively in the Uncertainty Section of the text.
[e] Soil screening levels (SSLs) for the protection of groundwater from EPA Region IX PRG table (EPA Region IX 2002). A dilution attenuation factor (DAF) of 1 assumes that no dilution occurs and the concentration in the receptor well equals the soil leachate concentration.
[f] Excess cancer risk = 1E-06 x (Maximum EPC / Carcinogenic PRG)
[g] HQ = Maximum EPC / Noncarcinogenic PRG
[h] Excess cancer risk = 1E-06 x (RME EPC / Carcinogenic PRG)
[i] HQ = RME EPC / Noncarcinogenic PRG
[k] An HQ for lead could not be determined because the PRGs for lead were developed using blood-lead levels and a reference dose is not available.
Shading identifies chemicals with concentrations exceeding EPA Region IX PRGs (EPA Region IX 2002).

Table 7-6 Screening PRE - Comparison of Surface Soil (0 - 1 feet bgs) EPCs at AA 3 to Industrial PRGs

												Maximum EPC Comparisons						RME EPC Comparisons					
												Carcinogenic			Noncarcinogenic			Carcinogenic			Noncarcinogenic		
Chemical	Number of Detects	Sample Size[a]	Frequency of Detection	Max EPC (mg/kg)[b]	95% UCL of Arithmetic Mean (mg/kg)	RME EPC (mg/kg)[c]	Background Concentration (mg/kg)	Carcinogenic PRG[d] (mg/kg)	Noncarcinogenic PRG[d] (mg/kg)	SSL DAF 1 (mg/kg)[e]	>SSL	>PRG (ca)	Excess Cancer Risk[f]	% Contribution to Risk	>PRG (nc)	HQ[g]	% Contribution to HI	>PRG (ca)	Excess Cancer Risk[h]	% Contribution to Risk	>PRG (nc)	HQ[i]	% Contribution to HI
Metals (6010B & 7471A)																							
Aluminum	33	33	100%	1.58E+04	1.02E+04	1.02E+04	14,800	--	1.00E+05	--	--	--	--	--	No	d	--	--	--	--	No	d	--
Antimony	1	33	3%	2.10E+00	5.71E+02	2.10E+00	3.06	--	4.09E+02	3.00E-01	Yes	--	--	--	No	5.14E-03	10%	--	--	--	No	5.14E-03	14%
Arsenic	33	33	100%	4.60E+00	3.19E+00	3.19E+00	6.86	1.59E+00	2.56E+02	1.00E+00	Yes	Yes	2.89E-06	25%	No	1.80E-02	35%	Yes	2.01E-06	64%	No	1.25E-02	34%
Barium	33	33	100%	1.87E+02	1.08E+02	1.08E+02	173	--	6.66E+04	8.20E+01	Yes	--	--	--	No	2.81E-03	5%	--	--	--	No	1.62E-03	4%
Beryllium	10	33	30%	3.10E-01	1.93E-01	1.93E-01	0.669	1.94E+03	--	3.00E+00	No	No	1.60E-10	0%	--	--	--	No	9.94E-11	0%	--	--	--
Cadmium	33	33	100%	1.00E+00	7.28E-01	7.28E-01	2.35	7.44E+00	4.51E+02	4.00E-01	Yes	No	1.34E-07	1%	No	2.22E-03	4%	No	9.79E-08	3%	No	1.61E-03	4%
Calcium	33	33	100%	2.52E+04	6.05E+03	6.05E+03	46,000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium	33	33	100%	1.58E+01	1.11E+01	1.11E+01	26.9	4.48E+02	--	2.00E+00	Yes	No	3.52E-08	0%	--	--	--	No	2.48E-08	1%	--	--	--
Cobalt	33	33	100%	7.60E+00	5.12E+00	5.12E+00	6.98	1.92E+03	--	--	--	No	3.96E-09	0%	--	--	--	No	2.66E-09	0%	--	--	--
Copper	33	33	100%	1.08E+01	6.95E+00	6.95E+00	10.5	--	4.09E+04	--	--	--	--	--	No	2.64E-04	1%	--	--	--	No	1.70E-04	0%
Iron	33	33	100%	1.94E+04	1.26E+04	1.26E+04	18,400	--	1.00E+05	--	--	--	--	--	No	d	--	--	--	--	No	d	--
Lead	33	33	100%	2.07E+01	8.88E+00	8.88E+00	15.1	--	7.50E+02	--	--	--	--	--	No	k	--	--	--	--	No	k	--
Magnesium	33	33	100%	6.90E+03	4.46E+03	4.46E+03	8,370	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	33	33	100%	2.89E+02	1.98E+02	1.98E+02	291	--	1.95E+04	--	--	--	--	--	No	1.49E-02	29%	--	--	--	No	1.02E-02	28%
Mercury	33	33	100%	6.90E-02	3.08E-02	3.08E-02	0.22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nickel	33	33	100%	1.21E+01	7.79E+00	7.79E+00	15.3	--	2.04E+04	7.00E+00	Yes	--	--	--	No	5.92E-04	1%	--	--	--	No	3.81E-04	1%
Potassium	33	33	100%	3.97E+03	2.70E+03	2.70E+03	4,890	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	20	33	61%	1.10E+00	5.42E-01	5.42E-01	0.32	--	5.11E+03	3.00E-01	Yes	--	--	--	No	2.15E-04	0%	--	--	--	No	1.06E-04	0%
Silver	1	33	3%	2.00E+00	6.32E-01	6.32E-01	0.539	--	5.11E+03	2.00E+00	No	--	--	--	No	3.91E-04	1%	--	--	--	No	1.24E-04	0%
Vanadium	33	33	100%	4.41E+01	2.84E+01	2.84E+01	71.8	--	7.15E+03	3.00E+02	No	--	--	--	No	6.16E-03	12%	--	--	--	No	3.97E-03	11%
Zinc	33	33	100%	5.71E+01	3.81E+01	3.81E+01	77.9	--	1.00E+05	6.20E+02	No	--	--	--	No	d	--	--	--	--	No	d	--
Extractable Hydrocarbons (8015B)																							
PHC as Diesel Fuel	14	33	42%	1.50E+01	6.28E+00	6.28E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PHC as Motor Oil	20	33	61%	1.60E+02	2.48E+01	2.48E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Purgeable Hydrocarbons (8015B)																							
PHC as Gasoline	26	33	79%	2.77E+00	9.07E-02	9.07E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Semivolitile Organics (8270C)																							
bis(2-Ethylhexyl) Phthalate	3	33	9%	7.00E-02	8.79E-02	7.00E-02	--	--	1.23E+02	--	--	--	--	--	No	5.69E-04	1%	--	--	--	No	5.69E-04	2%
Diethylphthalate	1	33	3%	2.25E-01	2.25E-01	2.25E-01	--	--	1.00E+05	--	--	--	--	--	No	d	--	--	--	--	No	d	--
Phenol	12	33	36%	9.36E-01	3.90E-01	3.90E-01	--	--	1.00E+05	5.00E+00	No	--	--	--	No	9.36E-06	0%	--	--	--	No	3.90E-06	0%
Semivolitile Organics (8270C-SIM)																							
Anthracene	1	33	3%	4.40E-02	1.56E-02	1.56E-02	--	--	1.00E+05	5.90E+02	No	--	--	--	No	4.40E-07	0%	--	--	--	No	1.56E-07	0%
Benzo(a)Anthracene	7	33	21%	7.30E-01	2.60E-02	2.60E-02	--	2.11E+00	--	8.00E-02	Yes	No	3.46E-07	3%	--	--	--	No	1.23E-08	0%	--	--	--
Benzo(a)pyrene	4	33	12%	1.03E+00	2.77E-02	2.77E-02	--	2.11E-01	--	4.00E-01	Yes	Yes	4.88E-06	43%	--	--	--	No	1.31E-07	4%	--	--	--
Benzo(b)Fluoranthene	5	33	15%	1.79E+00	3.36E-02	3.36E-02	--	2.11E+00	--	2.00E-01	Yes	No	8.48E-07	7%	--	--	--	No	1.59E-08	1%	--	--	--
Benzo(g,h,I)Perylene	4	33	12%	4.40E-01	2.28E-02	2.28E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(k)Fluoranthene	4	33	12%	5.10E-01	2.34E-02	2.34E-02	--	1.28E+00	--	2.00E+00	No	No	3.97E-07	3%	--	--	--	No	1.82E-08	1%	--	--	--
Chrysene	4	33	12%	8.70E-01	2.70E-02	2.70E-02	--	1.28E+01	--	8.00E+00	No	No	6.78E-08	1%	--	--	--	No	2.10E-09	0%	--	--	--
Dibenz(a,h)Anthracene	1	33	3%	9.70E-02	1.74E-02	1.74E-02	--	2.11E-01	--	8.00E-02	Yes	No	4.60E-07	4%	--	--	--	No	8.25E-08	3%	--	--	--
Fluoranthene	5	33	15%	1.00E+00	2.75E-02	2.75E-02	--		2.20E+04	2.10E+02	No	--	--	--	No	4.55E-05	0%	--	--	--	No	1.25E-06	0%
Indeno(1,2,3-c,d)Pyrene	2	33	6%	4.60E-01	2.32E-02	2.32E-02	--	2.11E+00	--	7.00E-01	No	No	2.18E-07	2%	--	--	--	No	1.10E-08	0%	--	--	--
Phenanthrene	2	33	6%	2.90E-01	2.09E-02	2.09E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pyrene	5	33	15%	9.60E-01	2.75E-02	2.75E-02	--	--	2.91E+04	2.10E+02	No	--	--	--	No	3.30E-05	0%	--	--	--	No	9.44E-07	0%
Dioxins and Furans (8290)																							
Total 2,3,7,8-TCDD	9	9	100%	1.84E-05	1.14E-05	1.14E-05	--	1.59E-05	--	--	--	Yes	1.16E-06	10%	--	--	--	No	7.16E-07	23%	--	--	--
Total 2,3,7,8-TCDD Bird	9	9	100%	3.53E-05	2.26E-05	2.26E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total 2,3,7,8-TCDD Fish	9	9	100%	1.82E-05	1.08E-05	1.08E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total 2,3,7,8-TCDD Mammal	9	9	100%	1.84E-05	1.14E-05	1.14E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cumulative Excess Cancer Risk/Hazard Index Including Background:													1.14E-05			5.13E-02			3.12E-06			3.63E-02	

NOTES:

-- = no data or not applicable
% = percent
ca = carcinogenic

HI = hazard index
mg/kg = milligrams per kilogram
nc = noncarcinogenic

PRG = preliminary remediation goals
SSL = soil screening levels
EPC = exposure point concentration

HI = hazard index
HQ = hazard quotient
RME = reasonable maximum exposure

[a] Sample size does not include field or laboratory quality control samples; field duplicate result is averaged with original sample result.
[b] Maximum EPC is the maximum detected concentration of an analyte.
[c] RME EPC is the minimum of either the 95% UCL of the arithmetic mean or the maximum EPC.
The 95% UCL is calculated as $e^{(mean + 0.5s^2 + sH/(n-1)^{0.5})}$, where mean = mean of the natural log transformed data; s = standard deviation of the natural log transformed data; H = H-statistic from EPA 1992; and n = number of samples.
[d] PRGs are based on cancer risk or noncarcinogenic health effects, unless qualified with a "sat" (soil saturation concentration) or "max" (ceiling limit concentration). Excess cancer risks or HQs are not calculated for chemicals of potential concern with non-risk-based PRGs (sat or max), which are discussed qualitatively in the Uncertainty Section of the text.
[e] Soil screening levels (SSLs) for the protection of groundwater from EPA Region IX PRG table (EPA Region IX 2002). A dilution attenuation factor (DAF) of 1 assumes that no dilution occurs and the concentration in the receptor well equals the soil leachate concentration.
[f] Excess cancer risk = 1E-06 x (Maximum EPC / Carcinogenic PRG)
[g] HQ = Maximum EPC / Noncarcinogenic PRG
[h] Excess cancer risk = 1E-06 x (RME EPC / Carcinogenic PRG)
[i] HQ = RME EPC / Noncarcinogic PRG
[k] An HQ for lead could not be determined because the PRGs for lead were developed using blood-lead levels and a reference dose is not available.
Shading identifies chemicals with concentrations exceeding EPA Region IX PRGs (EPA Region IX 2002).

Table 7-7: Screening PRE - Comparison of Subsurface Soil (>1 feet to 10 feet bgs) EPCs at AA 3 to Industrial PRGs

												Maximum EPC Comparisons						RME EPC Comparisons					
												Carcinogenic			Noncarcinogenic			Carcinogenic			Noncarcinogenic		
Chemical	Number of Detects	Sample Size[a]	Frequency of Detection	Max EPC (mg/kg)[b]	95% UCL of Arithmetic Mean (mg/kg)	RME EPC (mg/kg)[c]	Background Concentration (mg/kg)	Carcinogenic PRG[d] (mg/kg)	Noncarcinogenic PRG[d] (mg/kg)	SSL DAF 1 (mg/kg)[e]	>SSL	>PRG (ca)	Excess Cancer Risk[f]	% Contribution to Risk	>PRG (nc)	HQ[g]	% Contribution to HI	>PRG (ca)	Excess Cancer Risk[h]	% Contribution to Risk	>PRG (nc)	HQ[i]	% Contribution to HI
Metals (6010B & 7471A)																							
Arsenic	9	9	100.0%	4.63E+00	3.93E+00	3.93E+00	6.86	1.59E+00	2.56E+02	1.00E+00	Yes	Yes	2.91E-06	64%	No	1.81E-02	48%	Yes	2.47E-06	60%	No	1.54E-02	46%
Barium	9	9	100.0%	1.12E+02	1.00E+02	1.00E+02	173	--	6.66E+04	8.20E+01	Yes	--	--	--	No	1.68E-03	4%	--	--	--	No	1.50E-03	5%
Chromium	9	9	100.0%	1.64E+01	1.46E+01	1.46E+01	26.9	4.48E+02	--	2.00E+00	Yes	No	3.66E-08	1%	--	--	--	No	3.26E-08	1%	--	--	--
Cobalt	9	9	100.0%	5.33E+00	4.62E+00	4.62E+00	6.98	1.92E+03	--	--	--	No	2.77E-09	0%	--	--	--	No	2.40E-09	0%	--	--	--
Copper	9	9	100.0%	1.27E+01	1.04E+01	1.04E+01	10.5	--	4.09E+04	--	--	--	--	--	No	3.11E-04	1%	--	--	--	No	2.54E-04	1%
Lead	9	9	100.0%	1.33E+01	1.29E+01	1.29E+01	15.1	--	7.50E+02	--	--	--	--	--	No	k	--	--	--	--	No	k	--
Manganese	9	9	100.0%	2.32E+02	2.14E+02	2.14E+02	291	--	1.95E+04	--	--	--	--	--	No	1.19E-02	32%	--	--	--	No	1.10E-02	33%
Nickel	8	9	88.9%	1.37E+01	1.69E+01	1.37E+01	15.3	--	2.04E+04	7.00E+00	Yes	--	--	--	No	6.70E-04	2%	--	--	--	No	6.70E-04	2%
Vanadium	9	9	100.0%	3.56E+01	3.06E+01	3.06E+01	71.8	--	7.15E+03	3.00E+02	No	--	--	--	No	4.98E-03	13%	--	--	--	No	4.28E-03	13%
Zinc	9	9	100.0%	4.83E+01	4.31E+01	4.31E+01	77.9	--	1.00E+05	6.20E+02	No	--	--	--	No	d	--	--	--	--	No	d	--
Extractable Hydrocarbons (8015B)																							
PHC as Diesel Fuel	6	9	66.7%	5.60E+03	1.20E+05	5.60E+03	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Volatile Organics (8260B)																							
Acetone	5	9	55.6%	1.00E-01	8.19E-02	8.19E-02	--	--	6.04E+03	8.00E-01	No	--	--	--	No	1.66E-05	0%	--	--	--	No	1.36E-05	0%
Benzene	1	9	11.1%	2.45E-03	--	2.45E-03	--	1.31E+00	--	2.00E-03	Yes	No	1.86E-09	0%	--	--	--	No	1.86E-09	0%	--	--	--
Methylene Chloride	1	9	11.1%	9.20E-03	6.81E-03	6.81E-03	--	2.05E+01	--	1.00E-03	Yes	No	4.48E-10	0%	--	--	--	No	3.32E-10	0%	--	--	--
Semivolitile Organics (8270C)																	--						
Benzo(a)Anthracene	1	9	11.1%	2.70E-01	2.43E-01	2.43E-01	--	2.11E+00	--	8.00E-02	Yes	No	1.28E-07	3%	--	--	--	No	1.15E-07	3%	--	--	--
Benzo(a)pyrene	1	9	11.1%	2.30E-01	1.18E+00	2.30E-01	--	2.11E-01	--	4.00E-01	No	Yes	1.09E-06	24%	--	--	--	Yes	1.09E-06	26%	--	--	--
Benzo(b)Fluoranthene	1	9	11.1%	4.40E-01	3.96E-01	3.96E-01	--	2.11E+00	--	2.00E-01	Yes	No	2.09E-07	5%	--	--	--	No	1.88E-07	5%	--	--	--
Chrysene	1	9	11.1%	2.50E-01	2.28E-01	2.28E-01	--	1.28E+01	--	8.00E+00	No	No	1.95E-08	0%	--	--	--	No	1.78E-08	0%	--	--	--
Diethylphthalate	2	9	22.2%	2.60E-01	2.93E-01	2.60E-01	--	--	1.00E+05	--	--	--	--	--	No	d	--	--	--	--	No	d	--
Fluoranthene	1	9	11.1%	6.00E-01	6.06E-01	6.00E-01	--	--	2.20E+04	2.10E+02	No	--	--	--	No	2.73E-05	0%	--	--	--	No	2.73E-05	0%
Hexachlorbenzene	1	9	11.1%	1.50E-01	4.06E+00	1.50E-01	--	1.08E+00	--	1.00E-01	Yes	No	1.39E-07	3%	--	--	--	No	1.39E-07	3%	--	--	--
indeno(1,2,3-c,d)Pyrene	1	9	11.1%	8.10E-02	3.39E+01	8.10E-02	--	2.11E+00	--	7.00E-01	No	No	3.84E-08	1%	--	--	--	No	3.84E-08	1%	--	--	--
Phenanthrene	1	9	11.1%	1.40E-01	--	1.40E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pyrene	1	9	11.1%	4.60E-01	4.19E-01	4.19E-01	--	--	2.91E+04	2.10E+02	No	--	--	--	No	1.58E-05	0%	--	--	--	No	1.44E-05	0%
Dioxins and Furans (8290)																							
Total 2,3,7,8-TCDD	2	2	100.0%	4.24E-07	4.24E-07	4.24E-07	--	1.59E-05	--	--	--	No		0%	--	--	--	No	2.66E-08	1%	--	--	--
Total 2,3,7,8-TCDD Bird	2	2	100.0%	8.46E-03	8.46E-03	8.46E-03	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total 2,3,7,8-TCDD Fish	2	2	100.0%	8.43E-03	8.43E-03	8.43E-03	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total 2,3,7,8-TCDD Mammal	2	2	100.0%	4.76E-02	4.76E-02	4.76E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cumulative Excess Cancer Risk/Hazard Index Including Background:													4.58E-06			3.77E-02			4.12E-06			3.31E-02	

NOTES:

-- = no data or not applicable
% = percent
ca = carcinogenic
HI = hazard index
mg/kg = milligrams per kilogram
nc = noncarcinogenic
PRG = preliminary remediation goals
SSL = soil screening levels
EPC = exposure point concentration
HI = hazard index
HQ = hazard quotient
RME = reasonable maximum exposure

[a] Sample size does not include field or laboratory quality control samples; field duplicate result is averaged with original sample result.

[b] Maximum EPC is the maximum detected concentration of an analyte.

[c] RME EPC is the minimum of either the 95% UCL of the arithmetic mean or the maximum EPC.

The 95% UCL is calculated as $e^{(mean + 0.5s^2 + sH/(n-1)^{0.5})}$, where mean = mean of the natural log transformed data; s = standard deviation of the natural log transformed data; H = H-statistic from EPA 1992; and n = number of samples.

[d] PRGs are based on cancer risk or noncarcinogenic health effects, unless qualified with a "sat" (soil saturation concentration) or "max" (ceiling limit concentration). Excess cancer risks or HQs are not calculated for chemicals of potential concern with non-risk-based PRGs (sat or max), which are discussed qualitatively in the Uncertainty Section of the text.

[e] Soil screening levels (SSLs) for the protection of groundwater from EPA Region IX PRG table (EPA Region IX 2002). A dilution attenuation factor (DAF) of 1 assumes that no dilution occurs and the concentration in the receptor well equals the soil leachate concentration.

[f] Excess cancer risk = 1E-06 x (Maximum EPC / Carcinogenic PRG)

[g] HQ = Maximum EPC / Noncarcinogenic PRG

[h] Excess cancer risk = 1E-06 x (RME EPC / Carcinogenic PRG)

[i] HQ = RME EPC / Noncarcinogic PRG

[k] An HQ for lead could not be determined because the PRGs for lead were developed using blood-lead levels and a reference dose is not available.

Shading identifies chemicals with concentrations exceeding EPA Region IX PRGs (EPA Region IX 2002).

However, this is not possible for many chemicals because sufficiently credible database does not exist to allow such refinements. Therefore, EPA Region IX did not adjust toxicity values to correct for the fraction absorbed for any of the COPCs identified in the PRE (EPA 2002b).

For carcinogenic PAHs, relative potency factors (RPFs) developed by EPA were applied to estimate toxicity values for PAHs based on the relative potency of PAHs to B[a]P. The toxicity values for carcinogenic PAHs shown in Table 7-4 through Table 7-7 reflect the use of the RPFs as applied by EPA Region IX.

Of all the toxicity data that are available, some chemicals do have data to enable quantitative development of toxicity values. In these instances, the toxicity of these chemicals is evaluated qualitatively in Section 7.7, Uncertainty Analysis.

7.5.1.4 Screening Criteria—EPA Region IX PRGs for Soil

The screening criteria for use in the PRE are based on those PRGs that have been developed by EPA Region IX, assuming that exposure to chemicals at or below PRG concentrations represent a minimal risk to human health. For soil, two sets of exposure criteria exists:

Residential PRGs: A conservative set of PRGs are applicable to sites 1) that currently or are anticipated to be used for residential purposes, or 2) for which the DoN wishes to determine the potential for unencumbered transfer of property.

Industrial PRGs: One set is used for sites currently or anticipating industrial land use.

Some chemicals (e.g., TPH) do not have accepted remediation goals based on potential health effects, but do have levels that are suggested for use by state governments and/or local municipalities. These levels are often based on aesthetic criteria. In such instances, a non-health-based screening level was used for qualitative comparisons only. In other instances (i.e., lead), values deemed to be protective of the potential receptor groups are based on the potential for adverse health effects, but are not amenable to the evaluation of risk in the context of slope factors or reference doses. In this instance, screening levels for lead are included in the SPRE tables for comparison purposes, but are not used in the calculation of cumulative excess cancer risk or HI. Such comparisons for chemicals with non-risk-based screening levels are discussed in Section 7.5.4.

In summary, only EPA Region IX PRGs were used to derive estimates of carcinogenic risk and noncarcinogenic health effects. Excess cancer risk and HQs were not estimated for COPCs without available PRGs. Comparisons of the EPCs to non-risk-based screening levels were not included in the cumulative excess risk or the HI. Rather, these comparisons are presented qualitatively because the screening criteria are not risk-based.

7.5.2 Background Comparisons

The site is located in an area of California that characteristically has elevated levels of various elements (i.e., arsenic and chromium) in soil. Methods do exist to differentiate between concentrations of naturally occurring elements and those that may be associated with site related activities. This method (i.e., the onsite method) is a probabilistic methodology that has the potential to identify background concentrations thus allowing their exclusion from the risk assessment process per EPA (1989a). Derivation of the soil background concentrations for former MCAS El Toro is presented in the *Final Technical Memorandum, Background and Reference Levels, Remedial Investigations, Marine Corps Air Station, El Toro, California* (BNI 1996).

However, rather than eliminate elements detected at concentrations equal to or below their background concentrations before risk is characterized, all data, regardless of source origin, have been included in the determination of cancer risk and noncancer hazard, per EPA Region IX recommendations (Stralka 1995). Thus, incremental, or excess, risk is presented as the sum of estimated potential risks associated with all COPCs that exceed the EPA Region IX PRGs (EPA 2002b), irrespective of elevated chemical concentration that may not be related to facility activity. The contribution of background to overall site risks is discussed in SSPRE Section 7.6. A comparison of risk estimates including and excluding background concentrations are also presented in that section.

7.5.3 Estimation of Cumulative Health Risks

To evaluate risk from exposure to COPCs in soil, maximum EPC and RME EPCs were compared to their respective residential soil PRGs. The following soil and air pathways are considered in the development of soil PRGs:

- Incidental ingestion of chemicals in soil
- Dermal contact with chemicals in soil
- Inhalation of chemicals in fugitive dust
- Inhalation of VOCs

In accordance with EPA Region IX PRG guidance (EPA 2002b), exposure parameters for children aged 0 to 6 years were used to estimate noncarcinogenic residential PRGs. Age-adjusted exposure parameters were used to estimate carcinogenic residential PRGs for individuals from 0 to 30 years old (i.e., 30-year residents).

Excess (incremental) cancer risk associated with a COPC, using its EPC and carcinogenic PRG, was estimated using the following formula:

$$Excess\ Cancer\ Risk \quad = \quad TR \times \frac{EPC_i}{PRG_i}$$

Where:

TR = The target incremental lifetime cancer risk of $1x10^{-6}$
EPC_i = Maximum EPC or RME EPC of COPCi detected in soil (µg/kg or mg/kg)
PRG_i = PRG for $COPC_i$ in soil (µg/kg or mg/kg) based on carcinogenic effects

A HQ for COPC, using an EPC and its respective noncarcinogenic PRG, was estimated using the following formula:

$$Hazard\ Quotient(HQ) \quad = \quad THQ \times \frac{EPC_i}{PRG_i}$$

Where:
THQ = The target HQ of 1

The cumulative excess cancer risk is also estimated to evaluate potential exposure to multiple COPCs using the following equation:

$$\textit{Cumulative Excess Cancer Risk} = \sum_{i=1}^{i=n}\left[TR \times \frac{EPC_i}{PRG_i}\right]$$

The cumulative noncarcinogenic HI for exposure to multiple COPCs was estimated as follows:

$$\textit{Cumulative Noncarcinogenic Hazard Index} = \sum_{i=1}^{i=n}\left[THQ \times \frac{EPC_i}{PRG_i}\right]$$

If the cumulative excess cancer risk and noncancer HIs exceeded $1x10^{-6}$ and 1.0, respectively, and/or the lead EPC exceeded the residential PRG of 400 mg/kg, then the maximum EPCs and RME EPCs were compared to industrial soil PRGs.

7.5.4 Results of the Screening PRE

If maximum EPCs and RME EPCs were below residential PRGs, cumulative excess cancer risks were below 10^{-6}, the HI was less than 1.0, and the lead EPC was less than the EPA Region IX residential criterion of 400 mg/kg, then no further action was recommended for the site. As stated previously, if maximum EPCs and RME EPCs exceeded residential PRGs, the cumulative RME excess cancer risk exceeded 10^{-6}, the cumulative HI exceeded 1.0, and/or the lead EPC was less than 400 mg/kg, then the COPC concentrations in soil were compared to industrial PRGs.

If industrial PRGs were exceeded and the cumulative RME excess cancer exceeded 10^{-6}, the lead EPC exceeded the industrial PRG of 750 mg/kg (EPA 2002), and/or the cumulative HI exceeded 1.0, then a SSPRE was prepared.

7.5.4.1 Residential Land Use Evaluation

Because the site is located in a semi urban area, evaluation of the residential land use scenario can aid in determining if remediation is required to permit unrestricted transfer of the property. This section summarizes the results of the residential evaluation of both surface and subsurface soil. Tables 7-4 and 7-5 present the comparisons between maximum and RME EPCs and the EPA Region IX PRGs for surface and subsurface soil, respectively. It should be noted that the calculated noncancer hazard (i.e., HI) for the residential screening was less than 1.0 for all comparisons except the residential surface soil maximum and RME comparison. Thus, of the noncancer hazard evaluations, only the maximum and RME comparison for residential surface soil will be discussed. The results presented in Tables 7-4 and 7-5 are summarized below with emphasis on those chemicals that are associated with a majority of the excess cancer risk and noncancer hazard.

Surface Soil (0 to 1 feet bgs). The excess cancer risk and noncancer hazard assuming potential exposure to the maximum EPC is $4.2x10^{-5}$ and 1.6, respectively (Table 7-4). Arsenic, B[a]P, and total 2,3,7,8-TCDD (TEQ value) account for 28, 40, and 11 percent of the excess cancer risk, respectively. The HI was greater than the criterion of 1.0 with the majority of the HI attributed to iron (50 percent), arsenic (13 percent), aluminum (13 percent) and manganese (10 percent).

The excess cancer risk and noncancer hazard assuming potential exposure to the RME EPC are $1.3x10^{-5}$ and 1.1, respectively. Sixty-five percent of the excess cancer risk is attributed to arsenic while 23 percent of the excess cancer risk is attributed to 2,3,7,8-TCDD as TEQ. The HI was only marginally greater than the criterion of 1.0 with the majority of the HI attributed to iron (49 percent), manganese (10 percent), aluminum (12 percent), and arsenic (13 percent).

For lead, the maximum (20.7 mg/kg) and RME EPCs (8.88 mg/kg) do not exceed the residential criterion of 400 mg/kg. No further evaluation of the lead in surface soil is warranted.

Those chemicals detected in surface soils that are associated with risk and or hazards that exceed $1x10^{-6}$ and 1.0, respectively and are to be carried into the SSPRE are arsenic, benzo(a)anthracene, B[a]P, benzo(k)fluoranthene, dibenz(a,h)anthracene, and total 2,3,7,8-TCDD.

Subsurface Soil (greater than 1 to 10 feet bgs). The excess cancer risk, assuming potential exposure to the maximum EPC is $1.8x10^{-5}$ (Table 7-5). Arsenic and B[a]P account for 67 percent and 21 percent excess cancer risk, respectively.

The excess cancer risk assuming potential exposure to the RME EPC are $1.6x10^{-5}$ (Table 7-5). Arsenic and B[a]P account for 64 percent and 24 percent of excess cancer risk, respectively. The HI assuming potential exposure to both the maximum and RME EPC were less than 1.0.

For lead, neither the maximum EPC (13.3 mg/kg) nor the RME EPC (of 12.9 mg/kg) exceeded the residential standard. No further evaluation of the lead in subsurface soil is warranted.

Those chemicals detected in subsurface soils that are associated with risk and or hazards that exceed $1x10^{-6}$ and 1.0, respectively and are to be carried into the SSPRE are arsenic and B[a]P.

7.5.4.2 Industrial Land Use Evaluation

As indicated in Section 7.1.2, if the Tier 1A results indicate potentially undesirable health risks, the analysis proceeds to Tier 1B to derive more realistic, site-specific levels of risk. Therefore, exposure to surface and subsurface soil for the industrial scenario was evaluated. Tables 7-6 and 7-7 present the comparisons between maximum and RME EPCs and the EPA Region IX Industrial PRGs. These tables indicate that certain COPCs contribute to an excess carcinogenic risk above EPA permissible levels.

Surface Soil (0 to 1 feet bgs). The excess cancer risk, assuming potential exposure to the maximum EPC, is $1.1x10^{-5}$ (Table 7-6). Arsenic, B[a]P, and total 2,3,7,8-TCDD (TEQ value) constitute 25 percent, 43 percent, and 10 percent of the excess cancer risk, respectively.

The excess cancer risk, assuming potential exposure to the RME EPC, is $3.1x10^{-6}$. Arsenic and total 2,3,7,8-TCDD constitute 64 percent and 23 percent of the excess cancer risk, respectively. Assuming potential exposure to both the maximum and RME EPC, HIs were less than 1.0.

Those chemicals detected in surface soils that are associated with risk and or hazards that exceed $1x10^{-6}$ and 1.0, respectively, and are to be carried into the SSPRE are arsenic and B[a]P.

Subsurface Soil (greater than 1 to 10 feet bgs). The excess cancer risk, assuming potential exposure to the maximum EPC, is $4.6x10^{-6}$ (Table 7-7). Arsenic and B[a]P constitute 64 percent and 24 percent of the excess cancer risk, respectively.

The excess cancer risk assuming potential exposure to the RME EPC is 4.1×10^{-6}. Arsenic and B[a]P constitute 60 percent and 26 percent of the excess cancer risk, respectively. Assuming potential exposure to both the maximum and RME EPC, HIs were less than 1.0.

Those chemicals detected in subsurface soils that are associated with risk and or hazards that exceed 1×10^{-6} and 1.0, respectively, and are to be carried into the SSPRE are arsenic and B[a]P.

7.6 SITE-SPECIFIC PRE

A SSPRE was performed because, for any exposure scenario, a cumulative excess cancer risk of 1×10^{-6} or noncancer hazard of 1.0 was exceeded in the screening PRE. This section presents the SSPRE for receptors potentially exposed to chemicals that have been associated with excess cancer risk and noncancer hazard in performing the screening PRE. As noted in Section 7.6, the SPRE was conducted using PRGs for residential and industrial receptors. In the site-specific PRE, PRGs were developed for site-specific land use and exposure conditions that are not addressed in the development of the EPA Region IX PRGs.

7.6.1 Selection of COPCs

For the site-specific PRE, COPCs were identified as those chemicals with maximum EPCs that exceeded PRGs for soil and MCLs for groundwater in the screening PRE. The COPCs associated with soil are arsenic, benzo(a)anthracene, B[a]P, benzo(k)fluoranthene, dibenz(a,h) anthracene, and total 2,3,7,8-TCDD.

It should be reiterated that arsenic has been determined to be the over-riding COPC in soil. Details of the SSPRE are discussed below.

7.6.2 Receptor Selection and Exposure Factors

The site is designated as being located in a semi-urban setting and corresponding mix of land uses. Such uses include residential, industrial, and agricultural use. Future use plans for the site may include residential use. As noted in Section 7.4, since reuse has not been defined, several receptors are also evaluated to provide risk managers with risk estimates for alternate receptor scenarios. These receptors consist of visitors to the site, construction workers, agricultural workers, and individuals engaging in recreational activities. Activities that receptors may engage in are discussed below.

Visitors. Visitors are not anticipated to be on the site without direct supervision or authorization. There activities are expected to be limited to attending meetings, observing current work activities, reviewing land use plans, and such. Only contact with surface soil is anticipated. It is not unreasonable to assume that such visitors may access the site one day per month. However, in order to maintain sufficient conservatism in the assessment, visitors will be assumed to access the site one day each week of the year or 50 days per year. Because activities will not generally involve purposeful contact with soils (as may occur with agricultural workers) soil ingestion rates are assumed to be equal to those used for an adult resident (i.e., 100 mg per day [mg/day]). Remaining exposure factors are provided in Table 7-8.

Construction/Utility Workers. Exposure-relevant activities in which construction/utility workers may be engaged will typically include limited manual digging (substantial digging is typically done using mechanical equipment, which is likely to reduce the potential for exposure to soil), shoring excavation sidewalls, and removing and installing footings or utilities. In most instances, excavations are anticipated to be relatively shallow (i.e., 3 to 5 feet below grade). However, in situations that may require deeper excavations, such as the construction of additional buildings, excavation may be as deep as 10 feet. Due to the nature of the work, these receptors could be exposed to surface and subsurface soil during excavation work. Construction or utility work is expected to be of a relatively short-term periodic nature. For purposes of evaluating this receptor group, it is assumed that the construction/utility workers may access the site quarterly for two weeks. This results in an exposure frequency (EF) of 8 weeks per year or 40 days per year. Because activities will not generally involve purposeful contact with soils (as may occur with agricultural workers), soil ingestion rates (IR) are assumed to be equal to those assumed for an adult occupational IR of 100 mg/day. Remaining exposure factors for assessment of this receptor group are provided in Table 7-8.

Agricultural Workers. Agriculture in the area is a high yield, relatively mechanized process. It does not generally involve hand digging, harvesting, or manual irrigation. Nonetheless, such workers still spend a substantial amount of time on or near site soils, potentially resulting in exposures to soil. Water consumption during the course of agricultural work is very high. However, for potable purposes, clean water is provided to workers from offsite sources and is designated as such. Thus, ingestion of contaminated water is unlikely. However, irrigation systems may result in water aspiration that can facilitate dermal and inhalation exposure routes. For the purposes of evaluating risk to this receptor group, key exposure factors for soil exposures include IR (assumed to equal to 150 mg/day; intermediate between occupational and child residential ingestion rates) and skin contact area. For the water exposure route, exposed skin surface area is assumed to be 4,290 square centimeters (cm^2) (30 percent increased over that assumed in a typical occupational setting [3,300 cm^2]) due to potential removal of shirts during seasonally hot weather. The inhalation exposure is assumed to be equal to that applied to the occupational worker. Remaining exposure factors for assessment of this receptor group are provided in Table 7-8.

Recreational Receptor. As noted early in this report, the long-term plans consist of developing the land for recreational use. The specific recreational use is not defined at this time. However, it is not unreasonable to believe that the area may be used as nature park or fitness trail for use by local residents. Assuming that a combined use park is developed that allows for general nature observance and outdoor circuit fitness use, individuals may engage in activities once per week (i.e., taking nature walks) to three times per week (i.e., those engaged in regular fitness programs). Key exposure factors that are associated with these recreational uses are EF (EF set at 150 days per year), surface soil IR (IR set at 100 mg/day), and inhalation rates (IR for fitness use set at 3.3 m^3/hour [EPA 1997a] for 4 hours per day to 12 m^3 per day). Remaining exposure factors for assessment of this receptor group are provided in Table 7-8.

7.6.3 Estimation of Site-Specific PRGs

Cancer risks and hazard indices for the SSPRE were calculated in the same manner as described for the screening PRE. In the SSPRE, however, only those chemicals carried over from the SPRE are evaluated in a site-specific (construction/utility worker) context. Because the exposure parameters for the receptor groups differ from those used by EPA Region IX to develop residential or industrial PRGs, site-specific PRGs were developed according to the model below.

Table 7-8: Exposure Factors for Site-specific PRE for all exposure scenarios

Definition	Parameter	Units	Visitor		Agricultural Worker	Construction/ Utility Worker	Recreational Visitor	
			Adult	Juvenile			Adult	Juvenile
Ingestion Rate	IngR	mg/d	50	100	150	100	100	100
Fraction Ingestion from Source	FI	unitless	0.5	0.5	0.5	0.5	0.5	0.5
Inhalation Rate	InhR	m^3/hr	1	1	2.5	2.5	3.3	1.65
Particulate Emission Factor	PEF	m^3/kg	1.32E+09	1.32E+09	1.32E+09	1.32E+09	1.32E+09	1.32E+09
Exposed Surface Area	SA	cm^2/d	5700	4514	3300	3300	5700	2900
Adherence Factor	AF	mg/ cm^2	0.047	0.062	0.2	0.3	0.07	0.2
Absorption Factor	ABS	unitless	chemical specific	chemical specific	chemical specific	chemical specific	chemical specific	chemical specific
Exposure Time	ET	hr/d	4	8	10	8	4	4
Exposure Frequency	EF	d/yr	150	110	250	250	150	150
Exposure Duration	ED	yr	30	10	25	3	30	6
Conversion Factor	CF	kg/mg	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
Body Weight	BW	kg	70	55	70	70	70	55
Averaging Time								
Noncarcinogenic	AT	d	10950	3650	9125	1095	10950	2190
Carcinogenic	AT	d	25550	25550	25550	25550	25550	25550
Target Cancer Risk	TCR	unitless	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
Target Hazard Quotient	THQ	unitless	1	1	1	1	1	1

NOTES:

BW = body weight (kg)
CSFo = oral cancer slope factor for carcinogenic chemicals [(mg/kg-day) $^{-1}$]
IRS = ingestion rate of soil (milligram per day [mg/day])
CF = conversion factor (kilogram per milligram [kg/mg])
ABS = dermal absorption factor (unitless)
EV = event frequency (events per day)
ET = exposure time (hours/day)
ED = Exposure duration (yrs)
AT = carcinogenic averaging time (days)
CSFi = inhalation cancer slope factor for carcinogenic chemicals [(mg/kg-day) $^{-1}$
FI = fraction ingestion from source (unitless)
SA = exposed skin surface area (square centimeters [cm^2]/event)
AF = adherence factor (milligrams per square centimeter [mg/cm^2])
IRA = inhalation rate (cubic meters [m^3]/hour)
EF = exposure frequency (days per year [days/yr])
PEF = particulate emission factor (cubic meters per kilogram [m^3/kg])

7.6.3.1 SITE SPECIFIC PRG MODEL

The model used for estimating the site-specific PRGs via ingestion of soil, dermal contact with soil, and inhalation of particulates is shown below. This model is based on that used by EPA Region IX for the development of PRGs.

17 18 19

$$PRG_{ss} = \frac{TCRxBWxAT}{EDxEFx\left[\left(CSF_o xIRSxFIxCF\right) + \left(CSF_o xSAxABSxAFxEVxCF\right) + \left(CSF_i xIRAxETx\left(\frac{1}{PEF}\right)\right)\right]}$$

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Where: PRG_{ss} = Site-specific PRG for specific receptors (mg/kg)
TCR = Target cancer risk for exposure to carcinogenic chemicals (unitless)

7.6.4 Evaluation of Site-Specific PRE Results

The maximum EPCs and RME EPCs for COPCs in surface and subsurface soils were compared to PRGs developed specifically for the site-specific receptors. Cumulative excess cancer risks and the HQ (i.e., the HI) were calculated for those COPCs having EPCs greater than site-specific PRGs. However, since reuse has not been defined for the site and in order to provide risk managers with an upper limit of risk estimates, the residential scenario has been evaluated as part of the site-specific PRE. The results of the SSPRE (Tables 7-9 through 7-16) are discussed below. Table 7-17 summarizes those results.

7.6.4.1 RESIDENTIAL SCENARIO

Tables 7-9 and 7-10 present the results of the residential site-specific risk assessment.

Surface Soil (0 to 1 feet bgs). The excess cancer risk, assuming potential exposure to the maximum EPC, is $3.7x10^{-5}$ (Table 7-9). Thirty-two percent, 45 percent, and 13 percent of the cancer risk is associated with arsenic, B[a]P, and total 2,3,7,8-TCDD (TEQ value), respectively. The noncancer hazard was calculated to be less than HI of 1.0.

The excess cancer risk, assuming potential exposure to the RME EPC, is $1.2x10^{-5}$. Sixty-nine percent and 24 percent of the excess cancer risk are attributed to arsenic and total 2,3,7,8-TCDD (TEQ value), respectively. The HI was calculated to be less than 1.0.

Subsurface Soil (greater than 1 to 10 feet bgs). The excess cancer risk, assuming potential exposure to the maximum EPC, is $1.6x10^{-5}$ (Table 7-10). Seventy-four percent and 23 percent of the cancer risk is associated with arsenic and B[a]P, respectively. The noncancer hazard was calculated to be less than an HI of 1.0.

Similarly, the excess cancer risk, assuming potential exposure to the RME EPC, is $1.4x10^{-5}$. Seventy-one percent, and 26 percent of the cancer risk is associated with arsenic and B[a]P, respectively. The noncancer hazard was calculated to be less than an HI of 1.0 (Table 7-10).

7.6.4.2 CURRENT VISITOR

Table 7-11 presents the results of the current visitor site-specific risk assessment.

Surface Soil (0 to 1 feet bgs). The excess cancer risk, assuming potential exposure to the maximum EPC, is $3.6x10^{-6}$ (Table 7-11). Fifty-two percent, 28 percent, and 11 percent of the cancer risk is associated with B[a]P, arsenic, and total 2,3,7,8-TCDD (TEQ), respectively. The noncancer hazard was calculated to be less than an HI of 1.0.

The excess cancer risk, assuming potential exposure to the RME EPC, is 1.0×10^{-6}. Sixty-eight percent and 24 percent of the excess cancer risk is attributed to arsenic and total 2,3,7,8-TCDD (TEQ), respectively. The HI was calculated to be less than 1.0.

7.6.4.3 Construction/Utility Worker

Tables 7-12 and 7-13 present the results of the construction/utility worker site-specific risk assessment.

Surface Soil (0 to 1 feet bgs). The excess cancer risk and noncancer hazard assuming potential exposure to the maximum EPC are both less than the target risk of 1×10^{-6} and the target noncancer hazard (Table 7-12). Similarly, the excess cancer risk and noncancer hazard, assuming potential exposure to the RME EPC, are both less than the target risk of 1×10^{-6} and the target noncancer hazard (Table 7-12).

Subsurface Soil (greater than 1 to 10 feet bgs). The excess cancer risk and noncancer hazard assuming potential exposure to the maximum EPC, are both less than the target risk of 1×10^{-6} and the target noncancer hazard (Table 7-13). Similarly, the excess cancer risk and noncancer hazard, assuming potential exposure to the RME EPC, are both less than the target risk of 1×10^{-6} and the target noncancer hazard (Table 7-13).

7.6.4.4 Agricultural Worker

Tables 7-14 and 7-15 present the results of the site-specific risk assessment for agricultural worker.

Surface Soil (0 to 1 feet bgs). The excess cancer risk and noncancer hazard assuming potential exposure to the maximum EPC is 2.2×10^{-6}. The HI is less the target noncancer hazard (Table 7-14).

The excess cancer risk and noncancer hazard assuming potential exposure to the RME EPC, are both less than the target risk of 1×10^{-6} and the target noncancer hazard (Table 7-14).

Subsurface Soil (greater than 1 feet to 10 feet bgs). The excess cancer risk and noncancer hazard, assuming potential exposure to the maximum EPC, are both less than the target risk of 1×10^{-6} and the target noncancer hazard, respectively (Table 7-15). Similarly, the excess cancer risk and noncancer hazard, assuming potential exposure to the RME EPC, are both less than the target risk of 1×10^{-6} and the target noncancer hazard of 1 (Table 7-15).

7.6.4.5 Recreational User

Table 7-16 presents the results of the recreational user site-specific risk assessment.

Surface Soil (0 to 1 feet bgs). The excess cancer risk and noncancer hazard, assuming potential exposure to the maximum EPC, is 4.9×10^{-6} (Table 7-16). The HI is less the target noncancer hazard (Table 7-16).

The excess cancer risk and noncancer hazard, assuming potential exposure to the RME EPC, is 1.4×10^{-6} and is less than the target noncancer hazard (Table 7-16).

Table 7-9: Site-specific PRE - AA 3, Residential Scenario (Surface Soil [0 - 1 feet bgs])

											Maximum EPC Comparisons							RME EPC Comparisons					
												Carcinogenic			Noncarcinogenic			Carcinogenic			Noncarcinogenic		
Chemical	Number of Detects	Sample Size[a]	Frequency of Detection	Max EPC (mg/kg)[b]	95% UCL of Arithmetic Mean (mg/kg)	RME EPC (mg/kg)[c]	Background Concentration (mg/kg)	Carcinogenic PRG[d] (mg/kg)	Noncarcinogenic PRG[d] (mg/kg)	SSL DAF 1 (mg/kg)[e]	>SSL	>PRG (ca)	Excess Cancer Risk[f]	% Contribution to Risk	>PRG (nc)	HQ[g]	% Contribution to HI	>PRG (ca)	Excess Cancer Risk[h]	% Contribution to Risk	>PRG (nc)	HQ[i]	% Contribution to HI
Arsenic	33	33	100%	4.60E+00	3.19E+00	3.19E+00	6.86	3.90E-01	2.16E+01	1.00E+00	Yes	Yes	1.18E-05	32%	No	2.13E-01	100%	Yes	8.19E-06	69%	No	1.47E-01	100%
Benzo(a)Anthracene	7	33	21%	7.30E-01	2.60E-02	2.60E-02	--	6.21E-01	--	8.00E-02	Yes	Yes	1.17E-06	3%	--	--	--	No	4.18E-08	0%	--	--	--
Benzo(a)pyrene	4	33	12%	1.03E+00	2.77E-02	2.77E-02	--	6.21E-02	--	4.00E-01	Yes	Yes	1.66E-05	45%	--	--	--	No	4.46E-07	4%	--	--	--
Benzo(k)Fluoranthene	4	33	12%	5.10E-01	2.34E-02	2.34E-02	--	3.78E-01	--	2.00E+00	No	Yes	1.35E-06	4%	--	--	--	No	6.19E-08	1%	--	--	--
Dibenz(a,h)Anthracene	1	33	3%	9.70E-02	1.74E-02	1.74E-02	--	6.21E-02	--	8.00E-02	Yes	Yes	1.56E-06	4%	--	--	--	No	2.80E-07	2%	--	--	--
Total 2,3,7,8-TCDD	9	9	100%	1.84E-05	1.14E-05	1.14E-05	--	3.90E-06	--	--	--	Yes	4.72E-06	13%	--	--	--	Yes	2.92E-06	24%	--	--	--
Cumulative Excess Cancer Risk/Hazard Index Including Background:													3.72E-05			2.13E-01			1.19E-05			1.47E-01	
Cumulative Excess Cancer Risk/Hazard Index Excluding Background:													2.54E-05			0.00E+00			3.75E-06			0.00E+00	

NOTES:

-- = no data or not applicable
% = percent
ca = carcinogenic
HI = hazard index
mg/kg = milligrams per kilogram
nc = noncarcinogenic
PRG = preliminary remediation goals
SSL = soil screening levels
EPC = exposure point concentration
HI = hazard index
HQ = hazard quotient
RME = reasonable maximum exposure

[a] Sample size does not include field or laboratory quality control samples; field duplicate result is averaged with original sample result.
[b] Maximum EPC is the maximum detected concentration of an analyte.
[c] RME EPC is the minimum of either the 95% UCL of the arithmetic mean or the maximum EPC.
The 95% UCL is calculated as $e^{(mean + 0.5s^2 + sH/(n-1)^{0.5})}$, where mean = mean of the natural log transformed data; s = standard deviation of the natural log transformed data; H = H-statistic from EPA 1992; and n = number of samples.
[d] PRGs are based on cancer risk or noncarcinogenic health effects, unless qualified with a "sat" (soil saturation concentration) or "max" (ceiling limit concentration). Excess cancer risks or HQs are not calculated for chemicals of potential concern with non-risk-based PRGs (sat or max), which are discussed qualitatively in the Uncertainty Section of the text.
[e] Soil screening levels (SSLs) for the protection of groundwater from EPA Region IX PRG table (EPA Region IX 2002). A dilution attenuation factor (DAF) of 1 assumes that no dilution occurs and the concentration in the receptor well equals the soil leachate concentration.

[f] Excess cancer risk = 1E-06 x (Maximum EPC / Carcinogenic PRG)
[g] HQ = Maximum EPC / Noncarcinogenic PRG
[h] Excess cancer risk = 1E-06 x (RME EPC / Carcinogenic PRG)
[i] HQ = RME EPC / Noncarcinogic PRG
Shading identifies chemicals with concentrations exceeding EPA Region IX PRGs (EPA Region IX 2002).

Table 7-10: Site-specific PRE - AA 3, Residential Scenario (Subsurface Soil [>1 feet bgs to 10 feet bgs])

Chemical	Number of Detects	Sample Size [a]	Frequency of Detection	Max EPC (mg/kg)[b]	95% UCL of Arithmetic Mean (mg/kg)	RME EPC (mg/kg)[c]	Background Concentration (mg/kg)	Carcinogenic PRG[d] (mg/kg)	Noncarcinogenic PRG[d] (mg/kg)	SSL DAF 1 (mg/kg)[e]	>SSL	Maximum EPC Comparisons: Carcinogenic: >PRG (ca)	Excess Cancer Risk[f]	% Contribution to Risk	Noncarcinogenic: >PRG (nc)	HQ[g]	% Contribution to HI	RME EPC Comparisons: Carcinogenic: >PRG (ca)	Excess Cancer Risk[h]	% Contribution to Risk	Noncarcinogenic: >PRG (nc)	HQ[i]	% Contribution to HI
Arsenic	9	9	100%	4.63E+00	3.93E+00	3.93E+00	6.86	3.90E-01	2.16E+01	1.00E+00	Yes	Yes	1.19E-05	74%	No	2.14E-01	100%	Yes	1.01E-05	71%	No	1.82E-01	100%
Benzo(a)Anthracene	1	9	11%	2.70E-01	2.43E-01	2.43E-01	--	6.21E-01	--	8.00E-02	Yes	No	4.34E-07	3%	--	--	--	No	3.91E-07	3%	--	--	--
Benzo(a)pyrene	1	9	11%	2.30E-01	1.18E+00	2.30E-01	--	6.21E-02	--	4.00E-01	No	Yes	3.70E-06	23%	--	--	--	Yes	3.70E-06	26%	--	--	--
Total 2,3,7,8-TCDD	2	2	100%	4.24E-07	4.24E-07	4.24E-07	--	3.90E-06	--	--	--	No	1.09E-07	1%	--	--	--	No	1.09E-07	1%	--	--	--
Cumulative Excess Cancer Risk/Hazard Index Including Background:													1.61E-05			2.14E-01			1.43E-05			1.82E-01	
Cumulative Excess Cancer Risk/Hazard Index Excluding Background:													4.24E-06			0.00E+00			4.20E-06			0.00E+00	
														--									
														--									
														--									
														--									

NOTES:

-- = no data or not applicable
% = percent
ca = carcinogenic
HI = hazard index
mg/kg = milligrams per kilogram
nc = noncarcinogenic
PRG = preliminary remediation goals
SSL = soil screening levels
EPC = exposure point concentration
HI = hazard index
HQ = hazard quotient
RME = reasonable maximum exposure

[a] Sample size does not include field or laboratory quality control samples; field duplicate result is averaged with original sample result.
[b] Maximum EPC is the maximum detected concentration of an analyte.
[c] RME EPC is the minimum of either the 95% UCL of the arithmetic mean or the maximum EPC.
The 95% UCL is calculated as $e^{(mean + 0.5s^2 + sH/(n-1)^{0.5})}$, where mean = mean of the natural log transformed data; s = standard deviation of the natural log transformed data; H = H-statistic from EPA 1992; and n = number of samples.
[d] PRGs are based on cancer risk or noncarcinogenic health effects, unless qualified with a "sat" (soil saturation concentration) or "max" (ceiling limit concentration). Excess cancer risks or HQs are not calculated for chemicals of potential concern with non-risk-based PRGs (sat or max), which are discussed qualitatively in the Uncertainty Section of the text.
[e] Soil screening levels (SSLs) for the protection of groundwater from EPA Region IX PRG table (EPA Region IX 2002). A dilution attenuation factor (DAF) of 1 assumes that no dilution occurs and the concentration in the receptor well equals the soil leachat
[f] Excess cancer risk = 1E-06 x (Maximum EPC / Carcinogenic PRG)
[g] HQ = Maximum EPC / Noncarcinogenic PRG
[h] Excess cancer risk = 1E-06 x (RME EPC / Carcinogenic PRG)
[i] HQ = RME EPC / Noncarcinogic PRG

Shading identifies chemicals with concentrations exceeding EPA Region IX PRGs (EPA Region IX 2002).

Table 7-11: Site-specific PRE - AA 3, Visitor Scenario (Surface Soil [0 - 1 feet bgs])

Chemical	Number of Detects	Sample Size[a]	Frequency of Detection	Max EPC (mg/kg)[b]	95% UCL of Arithmetic Mean (mg/kg)	RME EPC (mg/kg)[c]	Background Concentration (mg/kg)	Carcinogenic PRG[d] (mg/kg)	Noncarcinogenic PRG[d] (mg/kg)	SSL DAF 1 (mg/kg)[e]	Maximum EPC Comparisons							RME EPC Comparisons					
												Carcinogenic			Noncarcinogenic			Carcinogenic			Noncarcinogenic		
											>SSL	>PRG (ca)	Excess Cancer Risk[f]	% Contribution to Risk	>PRG (nc)	HQ[g]	% Contribution to HI	>PRG (ca)	Excess Cancer Risk[h]	% Contribution to Risk	>PRG (nc)	HQ[i]	% Contribution to HI
Arsenic	33	33	100%	4.60E+00	3.19E+00	3.19E+00	6.86	4.58E+00	937.6	1.00E+00	Yes	Yes	1.00E-06	28%	No	4.91E-03	100%	No	6.97E-07	68%	No	3.40E-03	100%
Benzo(a)Anthracene	7	33	21%	7.30E-01	2.60E-02	2.60E-02	–	5.60E+00	–	8.00E-02	Yes	No	1.30E-07	4%	–	–	–	No	4.64E-09	0%	–	–	–
Benzo(a)pyrene	4	33	12%	1.03E+00	2.77E-02	2.77E-02	–	5.60E-01	–	4.00E-01	Yes	Yes	1.84E-06	52%	–	–	–	No	4.95E-08	5%	–	–	–
Benzo(k)Fluoranthene	4	33	12%	5.10E-01	2.34E-02	2.34E-02	–	5.60E+01	–	2.00E+00	No	No	9.11E-09	0%	–	–	–	No	4.18E-10	0%	–	–	–
Dibenz(a,h)Anthracene	1	33	3%	9.70E-02	1.74E-02	1.74E-02	–	5.60E-01	–	8.00E-02	Yes	No	1.73E-07	5%	–	–	–	No	3.11E-08	3%	–	–	–
Total 2,3,7,8-TCDD	9	9	100%	1.84E-05	1.14E-05	1.14E-05	–	4.58E-05	–	–	–	No	4.02E-07	11%	–	–	–	No	2.49E-07	24%	–	–	–
Cumulative Excess Cancer Risk/Hazard Index Including Background:													3.56E-06			4.91E-03			1.03E-06			3.40E-03	
Cumulative Excess Cancer Risk/Hazard Index Excluding Background:													2.55E-06			0.00E+00			3.35E-07			0.00E+00	

NOTES:

– = no data or not applicable
% = percent
ca = carcinogenic
HI = hazard index
mg/kg = milligrams per kilogram
nc = noncarcinogenic
PRG = preliminary remediation goals
SSL = soil screening levels
EPC = exposure point concentration
HI = hazard index
HQ = hazard quotient
RME = reasonable maximum exposure

[a] Sample size does not include field or laboratory quality control samples; field duplicate result is averaged with original sample result.
[b] Maximum EPC is the maximum detected concentration of an analyte.
[c] RME EPC is the minimum of either the 95% UCL of the arithmetic mean or the maximum EPC.
The 95% UCL is calculated as $e^{(mean + 0.5s^2 + sH/(n-1)^{0.5})}$, where mean = mean of the natural log transformed data; s = standard deviation of the natural log transformed data; H = H-statistic from EPA 1992; and n = number of samples.
[d] PRGs are based on cancer risk or noncarcinogenic health effects, unless qualified with a "sat" (soil saturation concentration) or "max" (ceiling limit concentration). Excess cancer risks or HQs are not calculated for chemicals of potential concern with non-risk-based PRGs (sat or max), which are discussed qualitatively in the Uncertainty Section of the text.
[e] Soil screening levels (SSLs) for the protection of groundwater from EPA Region IX PRG table (EPA Region IX 2002). A dilution attenuation factor (DAF) of 1 assumes that no dilution occurs and the concentration in the receptor well equals the soil leachat
[f] Excess cancer risk = 1E-06 x (Maximum EPC / Carcinogenic PRG)
[g] HQ = Maximum EPC / Noncarcinogenic PRG
[h] Excess cancer risk = 1E-06 x (RME EPC / Carcinogenic PRG)
[i] HQ = RME EPC / Noncarcinogic PRG
Shading identifies chemicals with concentrations exceeding EPA Region IX PRGs (EPA Region IX 2002).

Table 7-12: Site-specific PRE - AA 3, Construction Worker Scenario (Surface Soil [0 - 1 feet bgs])

												Maximum EPC Comparisons						RME EPC Comparisons					
												Carcinogenic			Noncarcinogenic			Carcinogenic			Noncarcinogenic		
Chemical	Number of Detects	Sample Size[a]	Frequency of Detection	Max EPC (mg/kg)[b]	95% UCL of Arithmetic Mean (mg/kg)	RME EPC (mg/kg)[c]	Background Concentration (mg/kg)	Carcinogenic PRG[d] (mg/kg)	Noncarcinogenic PRG[d] (mg/kg)	SSL DAF 1 (mg/kg)[e]	>SSL	>PRG (ca)	Excess Cancer Risk[f]	% Contribution to Risk	>PRG (nc)	HQ[g]	% Contribution to HI	>PRG (ca)	Excess Cancer Risk[h]	% Contribution to Risk	>PRG (nc)	HQ[i]	% Contribution to HI
Arsenic	33	33	100%	4.60E+00	3.19E+00	3.19E+00	6.86	1.99E+01	3.85E+02	1.00E+00	Yes	No	2.31E-07	24%	No	1.19E-02	100%	No	1.60E-07	66%	No	8.29E-03	100%
Benzo(a)Anthracene	7	33	21%	7.30E-01	2.60E-02	2.60E-02	--	1.83E+01	--	8.00E-02	Yes	No	3.99E-08	4%	--	--	--	No	1.42E-09	1%	--	--	--
Benzo(a)pyrene	4	33	12%	1.03E+00	2.77E-02	2.77E-02	--	1.83E+00	--	4.00E-01	Yes	No	5.63E-07	57%	--	--	--	No	1.52E-08	6%	--	--	--
Benzo(k)Fluoranthene	4	33	12%	5.10E-01	2.34E-02	2.34E-02	--	1.83E+02	--	2.00E+00	No	No	2.79E-09	0%	--	--	--	No	1.28E-10	0%	--	--	--
Dibenz(a,h)Anthracene	1	33	3%	9.70E-02	1.74E-02	1.74E-02	--	1.83E+00	--	8.00E-02	Yes	No	5.31E-08	5%	--	--	--	No	9.52E-09	4%	--	--	--
Total 2,3,7,8-TCDD	9	9	100%	1.84E-05	1.14E-05	1.14E-05	--	1.99E-04	--	--	--	No	9.25E-08	9%	--	--	--	No	5.73E-08	23%	--	--	--
Cumulative Excess Cancer Risk/Hazard Index Including Background:													**9.83E-07**			**1.19E-02**			**2.44E-07**			**8.29E-03**	
Cumulative Excess Cancer Risk/Hazard Index Excluding Background:													**7.52E-07**			**0.00E+00**			**8.35E-08**			**0.00E+00**	

NOTES:

-- = no data or not applicable
% = percent
ca = carcinogenic
HI = hazard index
mg/kg = milligrams per kilogram
nc = noncarcinogenic
PRG = preliminary remediation goals
SSL = soil screening levels
EPC = exposure point concentration
HI = hazard index
HQ = hazard quotient
RME = reasonable maximum exposure

[a] Sample size does not include field or laboratory quality control samples; field duplicate result is averaged with original sample result.
[b] Maximum EPC is the maximum detected concentration of an analyte.
[c] RME EPC is the minimum of either the 95% UCL of the arithmetic mean or the maximum EPC.
The 95% UCL is calculated as $e^{(mean + 0.5s^2 + sH/(n-1)^{0.5})}$, where mean = mean of the natural log transformed data; s = standard deviation of the natural log transformed data; H = H-statistic from EPA 1992; and n = number of samples.
[d] PRGs are based on cancer risk or noncarcinogenic health effects, unless qualified with a "sat" (soil saturation concentration) or "max" (ceiling limit concentration). Excess cancer risks or HQs are not calculated for chemicals of potential concern with non-risk-based PRGs (sat or max), which are discussed qualitatively in the Uncertainty Section of the text.
[e] Soil screening levels (SSLs) for the protection of groundwater from EPA Region IX PRG table (EPA Region IX 2002). A dilution attenuation factor (DAF) of 1 assumes that no dilution occurs and the concentration in the receptor well equals the soil leachat
[f] Excess cancer risk = 1E-06 x (Maximum EPC / Carcinogenic PRG)
[g] HQ = Maximum EPC / Noncarcinogenic PRG
[h] Excess cancer risk = 1E-06 x (RME EPC / Carcinogenic PRG)
[i] HQ = RME EPC / Noncarcinogic PRG

Table 7-13: Site-specific PRE - AA 3, Construction Worker Scenario (Subsurface Soil [>1 feet bgs to 10 feet bgs])

Chemical	Number of Detects	Sample Size[a]	Frequency of Detection	Max EPC (mg/kg)[b]	95% UCL of Arithmetic Mean (mg/kg)	RME EPC (mg/kg)[c]	Background Concentration (mg/kg)	Carcinogenic PRG[d] (mg/kg)	Noncarcinogenic PRG[d] (mg/kg)	SSL DAF 1 (mg/kg)[e]	>SSL	Maximum EPC Comparisons – Carcinogenic – >PRG (ca)	Maximum EPC Comparisons – Carcinogenic – Excess Cancer Risk[f]	Maximum EPC Comparisons – Carcinogenic – % Contribution to Risk	Maximum EPC Comparisons – Noncarcinogenic – >PRG (nc)	Maximum EPC Comparisons – Noncarcinogenic – HQ[g]	Maximum EPC Comparisons – Noncarcinogenic – % Contribution to HI	RME EPC Comparisons – Carcinogenic – >PRG (ca)	RME EPC Comparisons – Carcinogenic – Excess Cancer Risk[h]	RME EPC Comparisons – Carcinogenic – % Contribution to Risk	RME EPC Comparisons – Noncarcinogenic – >PRG (nc)	RME EPC Comparisons – Noncarcinogenic – HQ[i]	RME EPC Comparisons – Noncarcinogenic – % Contribution to HI
Arsenic	9	9	100.0%	4.63E+00	3.93E+00	3.93E+00	6.86	1.99E+01	3.85E+02	1.00E+00	Yes	No	2.33E-07	62%	No	1.20E-02	100%	No	1.97E-07	58%	No	1.02E-02	100%
Benzo(a)Anthracene	1	9	11.1%	2.70E-01	2.43E-01	2.43E-01	--	1.83E+01	--	8.00E-02	Yes	No	1.48E-08	4%	--	--	--	No	1.33E-08	4%	--	--	--
Benzo(a)pyrene	1	9	11.1%	2.30E-01	1.18E+00	2.30E-01	--	1.83E+00	--	4.00E-01	No	No	1.26E-07	34%	--	--	--	No	1.26E-07	37%	--	--	--
Total 2,3,7,8-TCDD	2	2	100.0%	4.24E-07	4.24E-07	4.24E-07	--	1.99E-04	--	--	--	No	2.13E-09	1%	--	--	--	No	2.13E-09	1%	--	--	--
Cumulative Excess Cancer Risk/Hazard Index Including Background:													3.75E-07			1.20E-02			3.39E-07			1.02E-02	
Cumulative Excess Cancer Risk/Hazard Index Excluding Background:													1.43E-07			0.00E+00			1.41E-07			0.00E+00	

NOTES:

-- = no data or not applicable

% = percent

ca = carcinogenic

HI = hazard index

mg/kg = milligrams per kilogram

nc = noncarcinogenic

PRG = preliminary remediation goals

SSL = soil screening levels

EPC = exposure point concentration

HI = hazard index

HQ = hazard quotient

RME = reasonable maximum exposure

[a] Sample size does not include field or laboratory quality control samples; field duplicate result is averaged with original sample result.

[b] Maximum EPC is the maximum detected concentration of an analyte.

[c] RME EPC is the minimum of either the 95% UCL of the arithmetic mean or the maximum EPC.

The 95% UCL is calculated as $e^{(mean + 0.5s^2 + sH/(n-1)^{0.5})}$, where mean = mean of the natural log transformed data; s = standard deviation of the natural log transformed data; H = H-statistic from EPA 1992; and n = number of samples.

[d] PRGs are based on cancer risk or noncarcinogenic health effects, unless qualified with a "sat" (soil saturation concentration) or "max" (ceiling limit concentration). Excess cancer risks or HQs are not calculated for chemicals of potential concern with non-risk-based PRGs (sat or max), which are discussed qualitatively in the Uncertainty Section of the text.

[e] Soil screening levels (SSLs) for the protection of groundwater from EPA Region IX PRG table (EPA Region IX 2002). A dilution attenuation factor (DAF) of 1 assumes that no dilution occurs and the concentration in the receptor well equals the soil leachate concentration.

[f] Excess cancer risk = 1E-06 x (Maximum EPC / Carcinogenic PRG)

[g] HQ = Maximum EPC / Noncarcinogenic PRG

[h] Excess cancer risk = 1E-06 x (RME EPC / Carcinogenic PRG)

[i] HQ = RME EPC / Noncarcinogic PRG

Shading identifies chemicals with concentrations exceeding EPA Region IX PRGs (EPA Region IX 2002).

Table 7-14: Site-specific PRE - AA 3, Agricultural Worker Scenario (Surface Soil [0 - 1 feet bgs])

											Maximum EPC Comparisons							RME EPC Comparisons					
												Carcinogenic			Noncarcinogenic			Carcinogenic			Noncarcinogenic		
Chemical	Number of Detects	Sample Size[a]	Frequency of Detection	Max EPC (mg/kg)[b]	95% UCL of Arithmetic Mean (mg/kg)	RME EPC (mg/kg)[c]	Background Concentration (mg/kg)	Carcinogenic PRG[d] (mg/kg)	Noncarcinogenic PRG[d] (mg/kg)	SSL DAF 1 (mg/kg)[e]	>SSL	>PRG (ca)	Excess Cancer Risk[f]	% Contribution to Risk	>PRG (nc)	HQ[g]	% Contribution to HI	>PRG (ca)	Excess Cancer Risk[h]	% Contribution to Risk	>PRG (nc)	HQ[i]	% Contribution to HI
Arsenic	33	33	100%	4.60E+00	3.19E+00	3.19E+00	6.86	7.17E+00	3.23E+02	1.00E+00	Yes	No	6.42E-07	28%	No	1.42E-02	100%	No	4.45E-07	68%	No	9.88E-03	100%
Benzo(a)Anthracene	7	33	21%	7.30E-01	2.60E-02	2.60E-02	–	8.70E+00	–	8.00E-02	Yes	No	8.39E-08	4%	–	–	–	No	2.99E-09	0%	–	–	–
Benzo(a)pyrene	4	33	12%	1.03E+00	2.77E-02	2.77E-02	–	8.70E-01	–	4.00E-01	Yes	Yes	1.18E-06	52%	–	–	–	No	3.18E-08	5%	–	–	–
Benzo(k)Fluoranthene	4	33	12%	5.10E-01	2.34E-02	2.34E-02	–	8.70E+01	–	2.00E+00	No	No	5.86E-09	0%	–	–	–	No	2.69E-10	0%	–	–	–
Dibenz(a,h)Anthracene	1	33	3%	9.70E-02	1.74E-02	1.74E-02	–	8.70E-01	–	8.00E-02	Yes	No	1.11E-07	5%	–	–	–	No	2.00E-08	3%	–	–	–
Total 2,3,7,8-TCDD	9	9	100%	1.84E-05	1.14E-05	1.14E-05	–	7.19E-05	–	–	–	No	2.56E-07	11%	–	–	–	No	1.59E-07	24%	–	–	–
Cumulative Excess Cancer Risk/Hazard Index Including Background:													2.28E-06			1.42E-02			6.59E-07			9.88E-03	
Cumulative Excess Cancer Risk/Hazard Index Excluding Background:													1.64E-06			0.00E+00			2.14E-07			0.00E+00	

NOTES:
– = no data or not applicable
% = percent
ca = carcinogenic
HI = hazard index
mg/kg = milligrams per kilogram
nc = noncarcinogenic
PRG = preliminary remediation goals
SSL = soil screening levels
EPC = exposure point concentration
HI = hazard index
HQ = hazard quotient
RME = reasonable maximum exposure

[a] Sample size does not include field or laboratory quality control samples; field duplicate result is averaged with original sample result.

[b] Maximum EPC is the maximum detected concentration of an analyte.

[c] RME EPC is the minimum of either the 95% UCL of the arithmetic mean or the maximum EPC.
The 95% UCL is calculated as $e^{(mean + 0.5s^2 + sH/(n-1)^{0.5})}$, where mean = mean of the natural log transformed data; s = standard deviation of the natural log transformed data; H = H-statistic from EPA 1992; and n = number of samples.

[d] PRGs are based on cancer risk or noncarcinogenic health effects, unless qualified with a "sat" (soil saturation concentration) or "max" (ceiling limit concentration). Excess cancer risks or HQs are not calculated for chemicals of potential concern with non-risk-based PRGs (sat or max), which are discussed qualitatively in the Uncertainty Section of the text.

[e] Soil screening levels (SSLs) for the protection of groundwater from EPA Region IX PRG table (EPA Region IX 2002). A dilution attenuation factor (DAF) of 1 assumes that no dilution occurs and the concentration in the receptor well equals the soil leachat

[f] Excess cancer risk = 1E-06 x (Maximum EPC / Carcinogenic PRG)

[g] HQ = Maximum EPC / Noncarcinogenic PRG

[h] Excess cancer risk = 1E-06 x (RME EPC / Carcinogenic PRG)

[i] HQ = RME EPC / Noncarcinogic PRG

Shading identifies chemicals with concentrations exceeding EPA Region IX PRGs (EPA Region IX 2002).

Table 7-15: Site-specific PRE - AA 3, Agricultural Worker Scenario (Subsurface Soil [>1 feet bgs to 10 feet bgs])

											Maximum EPC Comparisons							RME EPC Comparisons					
												Carcinogenic			Noncarcinogenic			Carcinogenic			Noncarcinogenic		
Chemical	Number of Detects	Sample Size[a]	Frequency of Detection	Max EPC (mg/kg)[b]	95% UCL of Arithmetic Mean (mg/kg)	RME EPC (mg/kg)[c]	Background Concentration (mg/kg)	Carcinogenic PRG[d] (mg/kg)	Noncarcinogenic PRG[d] (mg/kg)	SSL DAF 1 (mg/kg)[e]	>SSL	>PRG (ca)	Excess Cancer Risk[f]	% Contribution to Risk	>PRG (nc)	HQ[g]	% Contribution to HI	>PRG (ca)	Excess Cancer Risk[h]	% Contribution to Risk	>PRG (nc)	HQ[i]	% Contribution to HI
Arsenic	9	9	100.0%	4.63E+00	3.93E+00	3.93E+00	6.86	7.17E+00	3.23E+02	1.00E+00	Yes	No	6.46E-07	68%	No	1.43E-02	100%	No	5.48E-07	65%	No	1.22E-02	100%
Benzo(a)Anthracene	1	9	11.1%	2.70E-01	2.43E-01	2.43E-01	–	8.70E+00	–	8.00E-02	Yes	No	3.10E-08	3%	–	–	–	No	2.79E-08	3%	–	–	–
Benzo(a)pyrene	1	9	11.1%	2.30E-01	1.18E+00	2.30E-01	–	8.70E-01	–	4.00E-01	No	No	2.64E-07	28%	–	–	–	No	2.64E-07	31%	–	–	–
Total 2,3,7,8-TCDD	2	2	100.0%	4.24E-07	4.24E-07	4.24E-07	–	7.19E-05	–	–	–	No	5.90E-09	1%	–	–	–	No	5.90E-09	1%	–	–	–
Cumulative Excess Cancer Risk/Hazard Index Including Background:													9.47E-07			1.43E-02			8.46E-07			1.22E-02	
Cumulative Excess Cancer Risk/Hazard Index Excluding Background:													3.01E-07			0.00E+00			2.98E-07			0.00E+00	

NOTES:

-- = no data or not applicable
% = percent
ca = carcinogenic
HI = hazard index
mg/kg = milligrams per kilogram
nc = noncarcinogenic
PRG = preliminary remediation goals
SSL = soil screening levels
EPC = exposure point concentration
HI = hazard index
HQ = hazard quotient
RME = reasonable maximum exposure

[a] Sample size does not include field or laboratory quality control samples; field duplicate result is averaged with original sample result.

[b] Maximum EPC is the maximum detected concentration of an analyte.

[c] RME EPC is the minimum of either the 95% UCL of the arithmetic mean or the maximum EPC.
The 95% UCL is calculated as $e^{(mean + 0.5s^2 + sH/(n-1)^{0.5})}$, where mean = mean of the natural log transformed data; s = standard deviation of the natural log transformed data; H = H-statistic from EPA 1992; and n = number of samples.

[d] PRGs are based on cancer risk or noncarcinogenic health effects, unless qualified with a "sat" (soil saturation concentration) or "max" (ceiling limit concentration). Excess cancer risks or HQs are not calculated for chemicals of potential concern with non-risk-based PRGs (sat or max), which are discussed qualitatively in the Uncertainty Section of the text.

[e] Soil screening levels (SSLs) for the protection of groundwater from EPA Region IX PRG table (EPA Region IX 2002). A dilution attenuation factor (DAF) of 1 assumes that no dilution occurs and the concentration in the receptor well equals the soil leachate concentration.

[f] Excess cancer risk = 1E-06 x (Maximum EPC / Carcinogenic PRG)

[g] HQ = Maximum EPC / Noncarcinogenic PRG

[h] Excess cancer risk = 1E-06 x (RME EPC / Carcinogenic PRG)

[i] HQ = RME EPC / Noncarcinogic PRG

Shading identifies chemicals with concentrations exceeding EPA Region IX PRGs (EPA Region IX 2002).

Table 7-16: Site-specific PRE - AA 3, Recreational User (Adult/Child) (Surface Soil [0 - 1 feet bgs])

												Maximum EPC Comparisons						RME EPC Comparisons					
												Carcinogenic			Noncarcinogenic			Carcinogenic			Noncarcinogenic		
Chemical	Number of Detects	Sample Size[a]	Frequency of Detection	Max EPC (mg/kg)[b]	95% UCL of Arithmetic Mean (mg/kg)	RME EPC (mg/kg)[c]	Background Concentration (mg/kg)	Carcinogenic PRG[d] (mg/kg)	Noncarcinogenic PRG[d] (mg/kg)	SSL DAF 1 (mg/kg)[e]	>SSL	>PRG (ca)	Excess Cancer Risk[f]	% Contribution to Risk	>PRG (nc)	HQ[g]	% Contribution to HI	>PRG (ca)	Excess Cancer Risk[h]	% Contribution to Risk	>PRG (nc)	HQ[i]	% Contribution to HI
Arsenic	33	33	100%	4.60E+00	3.19E+00	3.19E+00	6.86	3.30E+00	5.96E+02	1.00E+00	Yes	Yes	1.39E-06	29%	No	7.72E-03	100%	No	9.67E-07	68%	No	5.35E-03	100%
Benzo(a)Anthracene	7	33	21%	7.30E-01	2.60E-02	2.60E-02	--	4.10E+00	--	8.00E-02	Yes	No	1.78E-07	4%	--	--	--	No	6.34E-09	0%	--	--	--
Benzo(a)pyrene	4	33	12%	1.03E+00	2.77E-02	2.77E-02	--	4.10E-01	--	4.00E-01	Yes	Yes	2.51E-06	51%	--	--	--	No	6.76E-08	5%	--	--	--
Benzo(k)Fluoranthene	4	33	12%	5.10E-01	2.34E-02	2.34E-02	--	4.10E+01	--	2.00E+00	No	No	1.24E-08	0%	--	--	--	No	5.71E-10	0%	--	--	--
Dibenz(a,h)Anthracene	1	33	3%	9.70E-02	1.74E-02	1.74E-02	--	4.10E-01	--	8.00E-02	Yes	No	2.37E-07	5%	--	--	--	No	4.24E-08	3%	--	--	--
Total 2,3,7,8-TCDD	9	9	100%	1.84E-05	1.14E-05	1.14E-05	--	3.35E-05	--	--	--	No	5.49E-07	11%	--	--	--	No	3.40E-07	24%	--	--	--
Cumulative Excess Cancer Risk/Hazard Index Including Background:													4.88E-06			7.72E-03			1.42E-06			5.35E-03	
Cumulative Excess Cancer Risk/Hazard Index Excluding Background:													3.49E-06			0.00E+00			4.57E-07			0.00E+00	

NOTES:
-- = no data or not applicable
% = percent
ca = carcinogenic
HI = hazard index
mg/kg = milligrams per kilogram
nc = noncarcinogenic
PRG = preliminary remediation goals
SSL = soil screening levels
EPC = exposure point concentration
HI = hazard index
HQ = hazard quotient
RME = reasonable maximum exposure

[a] Sample size does not include field or laboratory quality control samples; field duplicate result is averaged with original sample result.
[b] Maximum EPC is the maximum detected concentration of an analyte.
[c] RME EPC is the minimum of either the 95% UCL of the arithmetic mean or the maximum EPC.
The 95% UCL is calculated as $e^{(mean + 0.5s^2 + sH/(n-1)^{0.5})}$, where mean = mean of the natural log transformed data; s = standard deviation of the natural log transformed data; H = H-statistic from EPA 1992; and n = number of samples.
[d] PRGs are based on cancer risk or noncarcinogenic health effects, unless qualified with a "sat" (soil saturation concentration) or "max" (ceiling limit concentration). Excess cancer risks or HQs are not calculated for chemicals of potential concern with non-risk-based PRGs (sat or max), which are discussed qualitatively in the Uncertainty Section of the text.
[e] Soil screening levels (SSLs) for the protection of groundwater from EPA Region IX PRG table (EPA Region IX 2002). A dilution attenuation factor (DAF) of 1 assumes that no dilution occurs and the concentration in the receptor well equals the soil leachat
[f] Excess cancer risk = 1E-06 x (Maximum EPC / Carcinogenic PRG)
[g] HQ = Maximum EPC / Noncarcinogenic PRG
[h] Excess cancer risk = 1E-06 x (RME EPC / Carcinogenic PRG)
[i] HQ = RME EPC / Noncarcinogic PRG
[k] An HQ for lead could not be determined because the PRGs for lead were developed using blood-lead levels and a reference dose is not available.
Shading identifies chemicals with concentrations exceeding EPA Region IX PRGs (EPA Region IX 2002).

Table 7-17: Summary of Excess Cancer Risk and Hazard Quotient based on RME EPC Calculations

Type	Residential	Visitor	Construction Worker	Agricultural Worker	Recreational User
Surface - Including Background					
Cumulative ECR	**$1.2x10^{-5}$** Contributors 69% – arsenic 24% – total 2,3,7,8-TCDD (TEQ)	**$1.0x10^{-6}$** Contributors 68% – arsenic 24% – total 2,3,7,8-TCDD (TEQ)	$2.4x10^{-7}$ Contributors 66% – arsenic 23% – total 2,3,7,8-TCDD (TEQ)	$6.6x10^{-7}$ Contributors 68% – arsenic 24% – total 2,3,7,8-TCDD (TEQ)	**$1.4x10^{-6}$** Contributors 68% – arsenic 24% – total 2,3,7,8-TCDD (TEQ)
HI	<1	<1	<1	<1	<1
Surface - Excluding Background					
Cumulative ECR	**$3.8x10^{-6}$** Contributors 12% – B[a]P 7% – dibenz(a,h)anthracene 78% – total 2,3,7,8-TCDD (TEQ)	$3.4x10^{-7}$ Contributors 15% – B[a]P 9% – dibenz(a,h)anthracene 74% – total 2,3,7,8-TCDD (TEQ)	$8.4x10^{-8}$ Contributors 18% – B[a]P 11% – dibenz(a,h)anthracene 69% – total 2,3,7,8-TCDD (TEQ)	$2.1x10^{-7}$ Contributors 15% – B[a]P 9% – dibenz(a,h)anthracene 74% – total 2,3,7,8-TCDD (TEQ)	$4.6x10^{-7}$ Contributors 15% – B[a]P 9% – dibenz(a,h)anthracene 74% – total 2,3,7,8-TCDD (TEQ)
HI	<1	<1	<1	<1	<1
Subsurface - Including Background					
Cumulative ECR	**$1.4x10^{-5}$** Contributors 71% – arsenic 26% – B[a]P	—	$3.4x10^{-7}$ Contributors 58% – arsenic 37% – B[a]P	$8.5x10^{-7}$ Contributors 65% – arsenic 31% – B[a]P	—
HI	<1	—	<1	<1	—
Subsurface - Excluding Background					
Cumulative ECR	**$4.2x10^{-6}$** Contributors 9% – benz(a)anthracene 88% – B[a]P	—	$1.4x10^{-7}$ Contributors 9% – benz(a)anthracene 89% – B[a]P	$3.0x10^{-7}$ Contributors 9% – benz(a)anthracene 89% – B[a]P	—
HI	<1	—	<1	<1	—

NOTES:

ECR = excess cancer risk
HI = hazard index
— = not evaluated
RME-EPC = reasonable maximum exposure exposure point concentration

7.6.5 Site-Specific Risk Assessment Summary

Table 7-17 summarizes the results of the site-specific risk assessment.

The evaluation of only three site-specific surface soil scenarios using RME EPCs resulted in excess cancer risks that exceeded the target excess cancer risk level of $1x10^{-6}$: the visitor/surface soil scenario (excess cancer risk of $1.0x10^{-6}$), the recreational user/surface soil scenario (excess cancer risk of $1.4x10^{-6}$), and residential/surface soil scenario (excess cancer risk of $1.2x10^{-5}$). The excess cancer risk estimate of $1.2x10^{-5}$ for the residential surface soil scenario, which includes the contribution from arsenic, is within the EPA established risk management range of 10^{-6} to 10^{-4}. When arsenic is excluded because its RME EPC is less than background, the excess cancer risk decreases to $3.8x10^{-6}$, which is again well within the risk management range of 10^{-6} to 10^{-4}. Visitor scenario and recreational user surface soil excess cancer risks, including the arsenic contribution, are only marginally greater than the target excess cancer risk. Excluding the arsenic contribution from the visitor and recreational user surface soil scenarios decreases the estimated cancer risks to $3.4x10^{-7}$ and $4.6x10^{-7}$, respectively, which are less than the target excess cancer risk level of $1x10^{-6}$. None of the site-specific scenario evaluations resulted in non-cancer hazards that exceeded the target non-cancer hazard of 1.

The site-specific excess cancer risk estimates for subsurface soil, with the exception of the residential scenario ($1.4x10^{-5}$), are all below the target level of $1x10^{-6}$. The excess cancer risk estimate of $1.4x10^{-5}$ for the residential subsurface soil scenario, which includes the contribution from arsenic, is within the risk management range of 10^{-6} to 10^{-4}. When arsenic is excluded because its RME EPC is less than background, the excess cancer risk decreases to $4.2x10^{-6}$, which is again well within the risk management range of 10^{-6} to 10^{-4}. None of the site-specific scenario evaluations resulted in non-cancer hazards that exceeded the target non-cancer hazard of 1 (Table 7-17).

None of the site-specific scenario evaluations resulted in noncancer hazards that exceeded the target noncancer hazard of 1.0 (Tables 7-17).

7.7 UNCERTAINTY ANALYSIS

By design, this risk assessment has been developed to be protective, rather than accurately predictive. As a result, the risk assessment is believed to represent a substantial overestimation of cancer risk and noncancer hazard. This section presents a discussion of some of the uncertainties inherent in the risk assessment with focus on key factors believed to influence the risk assessment process and application to risk management activities. Uncertainties involved in each major step of the risk assessment process (i.e., exposure assessment, toxicity assessment, and risk characterization) are discussed separately below.

7.7.1 Uncertainties in Exposure Assessment

Uncertainty in the exposure assessment is a function of several factors. Such factors include but are not limited to; the completeness/representativeness of the site data, identification of COPCs, assumptions regarding actual current and/or future site land use, identification of relevant receptor groups and activities, and even the extent to which certain chemicals are physiologically retained and transferred to target organs of the selected receptors.

For this site investigation, the data that have been collected are believed to be reasonably representative of current site conditions. Several samples have been collected in a judgmental (i.e., biased) fashion over a period of three years at different depths in order to characterize the extent of contamination. The biased sampling procedures are likely to overestimate exposure and associated risk. COPCs have been selected based on prior knowledge of the site (i.e., use for construction debris disposal) and an understanding of conditions that are likely to influence chemical fate and transport.

Land use assumptions have been made to both ensure conservatism and attempt to realistically characterize current and future site use. Conservativeness is embodied in the SPRE that compares EPC to residential land use. This assumption overestimates risk but provides useful information to facilitate reasonable land use considerations. The SPRE evaluated alternate receptor scenarios. This evaluation is more likely to identify reasonably realistic risk given assumptions of receptor activities. Overall, therefore, selection and evaluation of the land uses in the risk assessment will tend, in general, to overestimate risks.Receptor groups have been selected to be consistent with generic and site-specific land uses. Therefore, the risk assessment has assumed that relevant receptor groups consist of residential and industrial receptors. All of the exposure factors that are used to characterize chemical intake are conservatively developed to ensure that, if anything, the risk is overestimated. Alternatively, the risk assessment has assumed that construction/utility workers, recreational users, visitors, and agricultural workers are relevant to a characterization of site-specific risks. Thus, these receptor groups have been evaluated with exposure factors that are somewhat less conservative but more realistic than the SPRE. For instance, despite the fact that current construction work activities result in reduced exposures (i.e., direct contact is minimized with the use of machinery), risk to the receptor has been evaluated using many exposure factors that are recommended as default factors by the EPA to ensure protectiveness in the risk assessment. Because many of the exposure factors used in the evaluation have been developed to ensure protectiveness, the tendency for risk to be overestimated is unlikely.

In summary, based on the assessment of sampling, land use, receptor selection, and associated activities and exposure factors, the exposure assessment is believed to overestimate risk.

7.7.2 Uncertainties in Toxicity Assessment

Toxicity assessment involves the selection of noncancer toxicity indices (i.e., RfDs) and cancer slope factors. RfDs are developed using animal data that must be applied to human receptors for the risk assessment. The process typically involves application of several uncertainty factors and modifying factors to animal test data that lower the RfD, given extrapolation from animal tests to human health risk assessment. For instance, uncertainty factors of 10 are often applied to animal data to reduce a threshold dose ten-fold to arrive at the RfD. This application of the UFs is likely to overestimate noncarcinogenic toxicity as noted by Dourson et. al. (1997).

Slope factors developed by the EPA are conservative and represent the upper bound limit (i.e., upper 95% UCL) on the probability of a cancer response occurring. Thus, the actual carcinogenic risk due to exposure to selected chemicals is likely to be lower than the actual risk experienced by the receptor. One other source of uncertainty in the toxicity assessment lies in extrapolating experimental carcinogenic observations at high doses to the low doses experienced by the human population of interest. Because there is no empirical way to detect risks below the 5 to 10 percent range, assumptions must be made about the shape of the dose-response curve in the low dose region (Rodricks, 1992). Because the standard default is to assume that all carcinogens have a linear no-threshold dose-response curve, the cancer potency for carcinogenic COPCs (i.e., arsenic and B[a]P) is likely overestimated.

The use of surrogate toxicity data (i.e., toxicity data used in lieu of COPC toxicity information) introduces uncertainty to the toxicity assessment. In many cases, toxicity values obtained under one route of exposure (i.e., oral) are used to represent toxicity values for another exposure route. When this is done, an effort is made to conservatively assume that the toxicity value is at least as conservative to that of the surrogate. The use, therefore, of surrogate toxicity data on the part of EPA for development of toxicity data will typically likely overestimate risk.

There is biological data supporting the theory that toxic responses in animals are similar to those in humans. However, the variability in responses to contaminant exposure can be large due to species differences in pharmacokinetic mechanisms such as absorption, distribution, metabolism, and excretion (Rodricks 1992).

7.7.3 Uncertainties in Estimation of Site-Related Risk

EPA guidance indicates that carcinogenic risks and HQs resulting from various multiple chemicals should be considered additive (EPA 1989a). In the absence of supporting data for synergy or antagonism, the assumption of additivity could overestimate or underestimate potential cancer risk or HQs for receptors.

As noted in the preceding text, arsenic is a predominant COPC that has been included in its entirety in the estimation of risk associated with site-related activities. Arsenic is also a common naturally occurring element found in soils similar to those of the site. The arsenic concentrations detected are consistent with background concentrations at El Toro. Additionally, the maximum and RME EPCs of arsenic are below the Station average. Therefore, the inclusion of the contribution of naturally occurring arsenic tends to overestimate risk to both generic and site-specific receptors.

7.8 RISK MANAGEMENT CONSIDERATIONS

Consistent with the NCP Preamble (Federal Register, Volume 55, No.49, Page 8717), several factors were considered by DoN for recommending No Further Action for AA 3 site based on the human health risk assessment results.

Per the NCP preamble, "Preliminary remediation goals for carcinogens are set at a 10^{-6} excess cancer risk as a point of departure, but may be revised to a different risk level with the acceptable risk range based on the consideration of appropriate factors including, but not limited to: exposure factors, uncertainty factors, and technical factors.

Included in the exposure factors are: the cumulative effect of multiple contaminants, the potential for human exposure from other pathways at the site, population, sensitivities, potential impacts on environmental receptors, and cross-media impacts of alternatives.

Factors related to uncertainty may include: the reliability of alternatives, the weight of scientific evidence concerning exposures and individual and cumulative health effects, and the reliability of exposure data.

Technical factors may include: detection/quantification limits for contaminants, technical limitations to remediation, the ability to monitor and control movement of contaminants, and background levels of contaminants. The final selection of the appropriate risk level is made when the remedy is selected based on the balancing of criteria...."

The primary factors considered by the DoN in recommending No Further Action for the site is the consideration of background levels of COPCs, detection frequency, spatial distribution and mobility.

7.8.1 Point of Departure Evaluation

Table 7-17 presents the summary of excess cancer risk and hazard quotient based on RME EPC calculations for residential, visitor, construction worker, agricultural worker, and recreational human receptors. With the exception of surface residential, surface visitor, surface recreational and subsurface residential users, the cancer and noncancer risk for all other scenarios were less than 10^{-6}. A point of departure evaluation using the NCP criteria will be conducted for risks associated with scenarios that were within the risk management range of 10^{-6} to 10^{-4}.

7.8.2 Background Level of Arsenic

The largest contributor to cancer risks at AA 3 is arsenic (Table 7-17). To evaluate the risk contributions of arsenic, the DoN estimated the total risk (including background) and the site risk after excluding contributions from background COPCs. The site risk after excluding contributions from background COPCs is consistently lower by an order of magnitude for surface residential and subsurface residential users. The site risk after excluding contributions from background COPCs for surface visitor and surface recreational receptors are less than 10^{-6}. This suggests that the arsenic concentration reported at the site is not a result of site-specific releases or contamination. None of the arsenic concentrations detected (33+4 duplicates) in surface soils exceeded the background concentrations (6.86 mg/kg) i.e., 100% of arsenic analytical results are less than former MCAS El Toro background arsenic concentrations. Also, none of the arsenic concentration detected in subsurface soils ranging from 1 to 10 feet bgs (9+1 duplicate) exceeded the background concentrations i.e., 100% of arsenic analytical results are less than former MCAS El Toro background arsenic concentrations.

7.8.3 Evaluation of Other Technical Factors

Other COPCs that have small contributions to the cancer risks include; dioxins-TEQs (Total 2,3,7,8-TCDD) in surface soils and B(a)P in subsurface soils. Of nine locations, (10 surface samples [including 1 duplicate]) analyzed for dioxins, only one sample location result exceeded the residential PRG concentration for total 2,3,7,8-TCDD) (3.9 pg/g). Of 10 subsurface soil samples (including 1 duplicate) analyzed for B(a)P, only 1 sample was detected at a concentration exceeding the residential PRG (61 µg/kg).

7.9 CONCLUSIONS AND RECOMMENDATIONS

The screening level risk assessment (i.e., comparison of data to residential and industrial criteria) resulted in cumulative excess cancer risks in the 10^{-6} range. None of the cumulative excess cancer risks exceeded 10^{-4}, a cancer risk level typically associated with recommended remedial activities. Based on the SSPRE, the noncancer hazard for residential/surface soil is less than 1.

The results of the site-specific risk assessments indicate that:

- The surface soils (0-1 feet bgs) indicate generally acceptable health risk for a residential reuse scenario. The risk is estimated to be 1.2×10^{-5}. Arsenic, concentrations of which are consistent with background, contributes to 69% of the risk with dioxins contributing 24%. When arsenic is excluded because its RME EPC is less than background, the excess cancer risk under the residential surface soil scenario decreases to 3.8×10^{-6}.

- The subsurface soils (greater than 1 feet to 10 feet bgs) do not pose a significant risk for a residential scenario, with the risk estimated at 1.4×10^{-5}. Arsenic and B[a]P contribute to 71% and 26% of the cancer risk, respectively. When arsenic is excluded because its RME EPC is less than background, the excess cancer risk decreases to 4.2×10^{-6}.

- The risk estimates for other receptor scenarios range from 2.4×10^{-7} (construction worker–surface soil scenario) to a maximum of 1.4×10^{-6} (recreational reuse surface soil scenario). In all cases arsenic contributes to a significant portion of the risk estimate. Excluding the arsenic contribution from the other receptor scenarios decreases the estimated cancer risks to less than $1x10^{-6}$.

- None of the site-specific surface and subsurface soil scenario evaluations resulted in non-cancer hazards that exceeded the target non-cancer hazard of 1.
- Based on the low concentrations of COPCs, low frequency of detections and spatial distribution, and low mobility characteristics of the few COPCs (e.g., arsenic, SVOCs, and dioxins/furans), AA 3 poses an acceptable risk to human health.

In summary, the risk estimates are well within the EPA established risk management range of 10^{-4} to 10^{-6}, and the hazard indices are below 1. Based on the data collected and its evaluation in the risk assessment, the site poses low risk to human health and no further evaluation of the site is necessary.